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**Thirty-ninth Annual Report of the Department of Agriculture (British Columbia) for the Year 1944.**—176 pp., 1 pl. Victoria, B.C. [1945.]

The Report of the Horticultural Branch (pp. 28–53) by W. H. Robertson includes a short account of the campaign against the pear Psyllid [*Psylla pyricola*, Först.] in British Columbia in 1940–44 [cf. *R.A.E.*, A **33** 142]. Other infested pear orchards, including some in Penticton and Summerland, were discovered in 1944 and were sprayed during the autumn. The spray used in the summer [cf. *loc. cit.*] was again applied in orchards south of Oliver. An account is also given of experiments against the mealybug [*Phenacoccus aceris*, Sign.] on apple to ascertain whether the addition of dinitrocresol to 3 per cent. distillate oil or the use of salts of dinitrocresol and dinitrocyclohexylphenol without oil would give as good results with lighter applications as the spray of 6 per cent. distillate oil previously recommended [cf. **31** 270]. The agitation of the spray machine used was insufficient to produce good emulsions, and lignin pitch at the rate of 8 oz. per 100 gals. was insufficient to emulsify the distillate oil after a solution of dinitrocresol in hot oil had been added to it, though it was satisfactory for the 6 per cent. oil alone or when the dinitrocresol was added to the oil in the spray tank as Dinitro Dry, which contains about 50 per cent. of a finely divided carrier. All spray quantities are given per 100 gals.; 3 per cent. oil, 8 oz. emulsifier, and 4 oz. oxalic acid [cf. **31** 153] were used in all sprays containing dinitrocresol, and no oil was used with the salts. The results are given as the average numbers of egg-masses per 10 pieces of spur wood 1 ft. long, and these averages were 2 for 1.1 lb. Dinitro Dry with Vatsol K as emulsifier; 2.8 for 0.6 lb. of the sodium salt of dinitrocyclohexylphenol and 2 oz. sodium lauryl sulphate; 3.8 for 2.2 lb. Dinitro Dry with sodium lauryl sulphate as the emulsifier; 4.6 and 4.8, respectively, for 1.1 lb. Dinitro Dry with sodium lauryl sulphate and lignin pitch as the emulsifiers; 6.2 when 0.56 lb. dinitrocresol dissolved in hot oil was added to the oil spray before emulsion with sodium lauryl sulphate; 9 and 11 for 0.6 lb. of the ammonium salt of dinitrocresol with 2 oz. Vatsol K and 2 oz. sodium lauryl sulphate, respectively; and 20.4 for the spray of 6 per cent. oil and 8 oz. lignin pitch alone. The averages on the five control trees ranged from 175 to 521.

In experiments on the control of the codling moth [*Cydia pomonella*, L.] on apple, 80–86 per cent. of the overwintering larvae were destroyed by spraying the trunks with a mixture of 15 gals. diesel oil and 3 lb. dinitro-cresol per 100 gals. If attack is heavy, infestation at harvest may be 50 per cent. lower on trees receiving this treatment as well as the summer schedule than on those that receive summer sprays alone. The addition of nicotine sulphate to the summer sprays reduced the percentage of infested fruit from 13.5 to 5.8.5. A spray of DDT was applied to three trees and gave good control of *C. pomonella*, but infestation by the European red mite [*Paratetranychus pilosus*, C. & F.] was heavier than on the controls. A spray of 1 lb. phenothiazine and 1 quart stove oil with casein-lime spreader per 100 gals. water gave good control when used against the first generation and followed by sprays of fixed nicotine and oil (5 lb. Mississippi bentonite,  $\frac{1}{2}$  pint nicotine sulphate and  $\frac{1}{2}$  gal. oil per 100 gals. water) against the second. *P. pilosus*, was more abundant in plots sprayed with phenothiazine than on others sprayed with cryolite with the addition of oil at a concentration of  $\frac{1}{2}$  gal. per 100 gals. in two applications and at  $\frac{1}{4}$  gal. in the rest. Sprays of Mississippi bentonite with nicotine sulphate and oil gave satisfactory control of *C. pomonella* when applied by growers, and are recommended for late applications where heavy sprays are necessary and residues of lead arsenate or cryolite are undesirable; it equals or exceeds these insecticides in effectiveness, and the oil may retard the development of *P. pilosus*. Artificial heating has proved effective in hastening the development of larvae of *C. pomonella* that have overwintered in used apple-boxes in packing sheds, and the value of combining this treatment with fumigation with methyl bromide to enable the

boxes to be taken to the orchards still earlier was tested. All the adults that emerged during the three days' exposure and some of the larvae present were killed by the gas, but a temperature of at least 65°F. is required for it to be effective, and prolonging the heating process is considered to be more economically practicable.

A spray of 5 gals. diesel oil and 2 lb. dinitro-cresol per 100 gals. applied at the rate of 500 gals. per acre to a heavy crop of buckwheat and weeds in a pear orchard in November 1943 gave an excellent kill of the tarnished plant bug [*Lygus oblineatus*, Say], but in the following spring damaged buds were as numerous on pear trees in the sprayed as in the unsprayed part of the orchard. In similar trials in which a dust that gave high mortality was applied to weeds under peach trees, there was no difference in the number of cat-faced peaches in treated and untreated parts of the orchard.

In the Report of the Provincial Entomologist (pp. 65-71), I. J. Ward describes the outbreak of *Melanoplus mexicanus*, Sauss., that occurred in 1944 [34 227]. Except in the Nicola Valley, where 70-80 per cent. of the grass on range land was destroyed, and the North Okanagan Valley, where lucerne and oats were seriously injured, damage was in general not heavy, largely owing to parasites and unfavourable climatic conditions. The production of honey was reduced by 60 per cent. in three districts, including these two, as a result of injury to nectar-producing plants. The area under potato in the East Kootenay district infested by *Leptinotarsa decemlineata*, Say, was smaller than in 1943 and control measures effectively prevented crop loss. Two new infestations were reported in the South Okanagan Valley; one affected only one plant. Cutworms increased markedly and caused damage early in the season, but attack by *Agrotis fennica*, Tauscher, which had injured lucerne in 1943 [cf. 33 154], was light and of short duration. The parsnip web-worm [*Depressaria heracleana*, L.] reduced the yield of parsnip seed by about 50 per cent. In the North Okanagan Valley, the turnip-seed weevil [*Ceuthorrhynchus assimilis*, Payk.], reduced the yield of turnip seed by up to 50 per cent. in one area and caused slight damage on cabbage and broccoli, and the wheat midge [*Sitodiplosis mosellana*, Géhin] and the cabbage Aphid [*Brevicoryne brassicae*, L.] were unusually injurious, frequent applications of a 4 per cent. nicotine dust being necessary throughout the season against the Aphid. *Hylemyia antiqua*, Mg., caused more damage to onions than in 1943 [cf. 33 154], but it was effectively controlled if a dust of calomel and hydrated lime was applied before infestation was observed and twice subsequently at intervals of ten days.

DEAN (G. A.). **The Elm Calligrapha** (*Calligrapha scalaris* Lec.).—*Circ. Kans. agric. Exp. Sta.* no. 234, 7 pp., 15 figs. Manhattan, Kans., 1946.

During the late spring and the early summer of 1944, American elms [*Ulmus americana*] in Kansas were defoliated by larvae and adults of *Calligrapha scalaris*, Lec.; this Chrysomelid, the egg, larva and adult of which are briefly described, has not previously been recorded as a serious pest of any shade tree, although it is widely distributed in the United States east of the Rocky Mountains and has been known in Kansas for more than 50 years. Severe damage was observed in seven localities in Kansas, and defoliation was also reported from one county in Oklahoma. This beetle has one generation a year in Kansas. The adults hibernate in clusters under loose bark, in crevices of the trunk or branches, under bands placed round the trunks against other insects, round the base of the trunks and in the surface soil under litter. They become active and crawl up the trees in early spring, after two or three consecutive days with temperatures of about 65°F. Oviposition begins when the leaves are one-fourth developed and continues until mid-June; the eggs are usually laid in clusters of 6-15 on green seed husks, leaves, twigs and bark of branches and trunks. The larvae feed on the leaves and crawl down the trunks to pupate

in the soil. The egg, larval and pupal stages last 14–21, 19–20 and 22–25 days, respectively. The adults emerge from mid-June to mid-July and feed on the leaves until early October, when they enter hibernation. During the summer and early autumn of 1944, thousands of the beetles were killed by the fungus, *Beauveria globulifera*.

A spray of 4 lb. lead arsenate and 4 U.S. pints spray oil in 100 U.S. gals. water, applied in early July, prevented further injury to infested elms. As a preventive measure, overwintering beetles clustering on the trunks and branches should be killed about the middle of November. In November 1944, about 6,000 beetles found under a band that had been placed around the trunk of an elm in February against cankerworms were killed by a liberal application of hot water; after the adhesive on the bands had been renewed in March 1945, several thousand more were found and killed on the band and trunk below it. Beetles were also destroyed by DDT applied as a 5 per cent. dust or in an oil base just below bands.

WALLACE (C. R.). **Protection of Plants from Black Beetle by DDT applied to the Soil.**—*J. Aust. Inst. agric. Sci.* **11** no. 3 pp. 135–139, 1 fig., 2 refs. Sydney, 1945.

A detailed account is given of tests already noticed in which a dust containing DDT was used as a soil dressing in February and March 1945 against *Heteronychus sanctae-helenae*, Blanch., in plots of marigold and cauliflower seedlings in New South Wales [*R.A.E.*, A **34** 208]. Late in March, when the cauliflowers were believed to be outgrowing their susceptible stage [*cf.* **34** 382], the crop was hilled up and the soil surrounding the plants previously treated was drenched with a dilute emulsion prepared by adding water to a stock solution of DDT in solvent naphtha with Wetsit; the final mixture contained 0.08 per cent. DDT and 0.5 per cent. solvent naphtha. No further signs of beetle activity were observed, even in the controls, so that the results were inconclusive; the only one of the 120 treated plants to show toxic symptoms attributable to the emulsion had had its tap root almost severed by an accidental injury. Cauliflowers that had received both treatments were eaten by the author in average daily portions of 8.2 oz. on 21 consecutive days without ill effects.

FRIEND (A. H.). **Experiments on the Control of the Bean Seed Weevil.**—*J. Aust. Inst. agric. Sci.* **11** no. 3 pp. 139–141. Sydney, 1945.

Accounts are given of two experiments, carried out in New South Wales in 1943 and 1945, in which various inert and insecticidal dusts were tested for protecting bean seed against *Bruchus obtectus*, Say. Infested bean seeds were mixed with uninfested seeds and divided into samples, each of which was shaken up with the dust under test, enclosed in a calico bag and further infested with adults, eggs and, in the first test, newly hatched larvae. Counts were made five months later, when two generations of adults had emerged, and the results were analysed statistically. The apparent order of effectiveness of the materials used in the first test, the weights given being per bushel of seed, was 8 oz. and 4 oz. copper oxychloride and 8 oz. copper carbonate, which all gave complete protection, 2 oz. copper oxychloride, 4 oz. copper carbonate, 4 oz. and 8 oz. sodium fluosilicate, 1 lb. of a mixture of pyridine and kaolin (1 : 20), 2 oz. sodium fluosilicate, 2 oz. copper carbonate, 1 lb. kaolin, 1 lb. of a mixture of sulphur and lime (1 : 1), 1 lb. dolomite, 1 lb. lime, 1 lb. of a mixture of derris and kaolin (1 : 7), 1 lb., 8 oz. and 4 oz. magnesite, and 1 oz. naphthalene. Differences between treatments were in many cases not significant, but all treatments except naphthalene were significantly better than no treatment. In the second experiment, in which the samples were kept at a temperature of 70°F., 10 per cent. DDT mixed with kaolin or adsorbed on kaolin or pyrophyllite

(used in each case at 1 lb. per bushel), gave complete protection, 1 lb. kaolin and 1 lb. magnesite were significantly better than 2 oz. copper oxychloride, 1 lb. of a heavier type of kaolin or 1 lb. pyrophyllite, and the only treatment not significantly better than none was 2 oz. of the fungicidal seed dust Spergon (tetra-chlorparabenzquinone).

It is pointed out that the three types of kaolin and the two types of magnesite used gave very different results, and that pyrophyllite did not adhere well to the seed. The dosage of DDT used was probably excessive, but it caused very little loss of germinating power in old seed.

RUNGS (C.). **La lutte contre les criquets pèlerins adultes au cours de la campagne 1944-45.**—*Terre maroc.* 15 no. 190 pp. 12-13. Casablanca, 1945.

Poison baits gave satisfactory results against adults of *Schistocerca gregaria*, Forsk., in preliminary trials in Morocco and Algeria in 1944, and tests on a larger scale were accordingly made in Morocco during 1945. Little control of the hoppers was required during the intervening period, since many eggs failed to hatch owing to the extreme dryness of the soil and the activities of parasites. In the autumn of 1944, swarms of adults that entered south-eastern Morocco quickly passed eastwards into Algeria, but others that entered south-western Morocco from Mauretania and Rio de Oro settled in the Sus Valley, where they remained from December until the end of February; they were estimated to be present over an area of about 380 square miles.

A bait of moistened wheat bran containing 8 per cent. sodium fluosilicate by weight, applied over an area of nearly 3 square miles between 24th January and 3rd February, 1945, was readily consumed by the immature adults, but was difficult to apply owing to the great activity of the swarms. A second series of tests, made at the beginning of February against locusts that were beginning to oviposit, gave excellent control. The bait was accordingly applied on an extensive scale against the adults in four districts in western Morocco between early March and 21st June, and the outbreak was practically annihilated as a result; barely a quarter of the population escaped, and this comprised locusts that remained in mountainous regions, often at altitudes exceeding 6,500 ft., or in the south-eastern deserts. The experiment indicated that bait applied at an average rate of 22½ lb. per acre gives a high mortality. In view of the saving in bait materials that would be gained by destroying the adults before they had oviposited, it is proposed in future to attempt to destroy the swarms before they cross the High Atlas Mountains.

BÁGUENA CORELLA (L.). **Observaciones sobre Longicornios perjudiciales a varios cultivos arbóreos, y especialmente a los de cacao y café en los Territorios Españoles del Golfo de Guinea.** [Notes on some Longicorns harmful to cultivated Trees, including Cacao and Coffee, in the Spanish Territories in the Gulf of Guinea.]—*Publ. Direcc. Agric. Territ. esp. Golfo Guinea* no. 6 (Anu. 1942) pp. 39-91, 14 pls. (7 col.), 4 figs., 15 refs. Madrid, 1942.

The author reviews the habits and classification of Longicorn beetles, and gives notes on the bionomics and morphology of certain species that are injurious to cultivated trees in Fernando Po and Spanish Guinea. These are *Mallodon* (*Stenodontes*) *downesi*, Hope, on cacao, mango, avocado and ylang-ylang [*Cananga odorata*], *Bixadus sierricola*, White, on coffee, species of *Tragocephala* and *Sternotomis* on cacao and coffee, and an unidentified Lamiid on *Albizia lebbek*.

Adults of the Prionid, *M. downesi*, were present throughout the year, though their maximum length of life was 20 days in the laboratory. The females lay

their eggs in crevices under the bark of many kinds of wood, but prefer old or damaged trees in which the hard wood is covered by a layer of partly rotten tissue; the larvae tunnel into this on hatching and later enter the harder wood. Pupation takes place in an enlarged chamber in the gallery, and the adults emerged from the wood 10–15 days later. Infestation is not usually suspected until the tree begins to wilt. There are often as many as two dozen larvae in one tree, and branches riddled with galleries break and fall.

*B. sierricola* is the most serious pest of coffee in these territories. Adults of this Lamiid lived for up to 36 days in the laboratory, and groups of up to 6 eggs were laid on several successive nights on the lower parts of the trunk, near the ground. Well cultivated or neglected trees, in exposed or shaded positions, were attacked, but not very young plants. The larvae hatch in 6–7 days and tunnel through the liber and cambium beneath the bark. As the larva grows, this layer becomes too shallow for the tunnel, and it tends to burst through the bark; at this point the larva turns and mines into the wood. Once the centre is reached, it tunnels straight up the trunk until it is full-fed. The pupal stage lasts 11–12 days, and the adult bores its way out after another 3–4 days. As with *Mallodon*, the attack is usually unnoticed until its final stages, when the tree is already dying. On two occasions, adults of the Ichneumonid, *Gabunia ruficoxis*, Kriechb., emerged from galleries of *B. sierricola* in the laboratory.

Lists are given of the species of *Sternotomis* and *Tragocephala* that have been recorded from cacao and coffee in other parts of Africa and of those that occur in Spanish Guinea and Fernando Po. All are thought to be injurious. Adults of these Lamiids are present throughout the year but are most abundant at the beginning of the dry seasons, in December–January and in June–July. The females deposit 30–40 eggs singly beneath the bark of green shoots, and the larvae bore into the twigs and tunnel down them. Small openings are formed along these galleries, probably as outlets for frass and for the sap, which is abundant in the shoots. The larval stage lasts about five months, at the end of which the larva enlarges the end of the tunnel, stops up the entry and pupates. The pupal stage is thought to last 20–25 days.

The unidentified Lamiid on *Albizzia lebbek*, which is used as a shade tree in coffee plantations, was observed at the Experiment Station at Santa Isabel, Fernando Po, and it was later found in one ylang-ylang tree there. One or two eggs were laid together under loose bark in crevices of the trunk. The larvae hatched in 8–9 days and fed on the liber, beneath the bark, giving rise to considerable exudation of resin; ants and other insects infest the wounds and prevent them from healing. The pupal cell is hollowed out in the wood; the pupal stage lasts 10–12 days, and the adult emerges after a further 2–3 days.

Descriptions are given in appendices of the larva and adult of *M. downesi*, together with keys to the species and varieties of *Sternotomis* and *Tragocephala* from Fernando Po and Spanish Guinea and short descriptions of the adults. They include one new variety from Spanish Guinea in each genus.

BÁGUENA CORELLA (L.). **Un grave peligro para el ylang-ylang en Fernando Póo.** *Bunaea alcinoë* Cramer (Lepidoptera Saturniidae) sobre *Cananga odorata* Hook. (Anonaceae). [A grave Danger to Ylang-Ylang in Fernando Po.]—*Publ. Direcc. Agric. Territ. esp. Golfo Guinea* no. 7 (Bol. 1943 no. 1) pp. 27–48, 6 pls. (2 col.). Madrid, 1943.

The author reviews the systematic position of *Bunaea alcinoë*, Stoll, describes all stages of this Saturniid briefly in the text and the larva and adults more fully in an appendix and states that he has recently observed the larvae defoliating ylang-ylang (*Cananga odorata*) in an experimental plantation in Fernando Po. It is a native species and is known to feed on various forest trees.

Field and laboratory observations showed that there are two generations a year, the adults emerging in late February and late August, at the beginning of the dry seasons. Pairing took place soon after emergence, and the eggs were laid 2-3 nights later; they are deposited in batches on the upper surfaces of the leaves. The larvae hatched in 8-15 days and became full-fed in about three months. They were most numerous in the tops of the trees, where the leaves were fresher, and caused serious defoliation. At the beginning of the rains, in May and November, they crawled to the ground in search of sites for pupation and spun cocoons just below the surface of soft soil. Many do not find suitable sites and die, and pupae were observed in some cases as much as 60 yards from the trees. The pupal stage lasted throughout the three months' rainy seasons and the adults survived for about a week.

Scarcely any flowers were produced by heavily infested trees, and a much reduced number by those harbouring the larvae from even a single egg-cluster. Suggested methods of control comprise hand collection of the larvae in plantations and spraying single ornamental trees with lead arsenate or nicotine. Quick-lime may be dusted round the base of infested trees, to destroy the larvae when they descend.

ÁLVAREZ APARICIO (J.). **Absorción de gases desinfectantes por los granos de cacao.** [Absorption of disinfectant Gases by Cacao Beans.]—*Publ. Direcc. Agric. Territ. esp. Golfo Guinea* no. 7 (Bol. 1943 no. 1) pp. 61-75, 1 pl. Madrid, 1943.

Owing to dislocation of transport, cacao beans produced in Fernando Po have of recent years been kept in storage for long periods and have become infested by *Ephesia cautella*, Wlk., and *Araecerus fasciculatus*, Deg., of which the first is the commoner. With a view to controlling these insects by fumigation, tests were carried out to ascertain whether harmful quantities of carbon bisulphide, hydrocyanic acid gas and sulphur dioxide would be absorbed and retained by cacao beans. A full account is given of the apparatus and methods employed. Cacao beans exposed for 48 hours to carbon bisulphide at the rate of 4 oz. per 10 cu. ft. were found to have absorbed 0.2108 per cent. of their weight of the fumigant. The amount retained was reduced to 0.1146 per cent. after 24 hours' exposure to the air, and the gas was practically eliminated after 48 hours. After fumigation for 24 hours with hydrocyanic acid gas at the rate of 1.5 oz. per 10 cu. ft., the percentages retained were 0.02811 immediately after treatment, 0.01752 after ventilation for 24 hours and 0.00252 after 48 hours. The amount of sulphur dioxide absorbed during exposure for 24 hours to a saturated atmosphere of this gas produced by burning sulphur with potassium nitrate to facilitate combustion was infinitesimal and was entirely eliminated by ventilation for 24 hours. It is concluded that dangerous amounts of fumigants would not be retained after fumigation, and that any traces would be dispersed in the process of roasting. Fumigation had no effect on the quality of the beans.

If possible, the fumigants should be applied in a chamber constructed of metal or painted with cellulose or oil paint, these being materials that absorb a minimum of gas. Carbon bisulphide can be mixed with 20 per cent. carbon tetrachloride to decrease its inflammability. It is ineffective against the eggs, so that treatment must be repeated to give complete control. The concentrations employed in the tests were greater than those required for control, which are about 1 oz. carbon bisulphide per ton of cacao beans for an exposure of 48 hours under a tarpaulin or in a fumigation chamber and about 55 oz. hydrocyanic acid gas and 40 oz. sulphur (with 2-3 oz. potassium nitrate) per 1,000 cu. ft., both for exposures of 24 hours. Hydrocyanic acid gas penetrates more easily through bagged cacao than through beans stored loose, and both this gas and sulphur dioxide must be applied in a sealed chamber.

JACOB (F. H.). **Note on the Classification of the British Species of "Black Aphides" (Hemiptera, Aphididae).**—*Proc. R. ent. Soc. Lond.* (B) **14** pt. 7-8 pp. 102-110, 23 refs. London, 1945.

The author gives a detailed summary of the literature relating to the nomenclature and classification of *Aphis fabae*, Scop., and allied species [R.A.E., A **14** 193; **19** 181; **30** 473; etc.] to introduce a discussion of the species that have been collected by him in England and Wales. He adopts the system of classification given by Börner and Schilder in Sorauer's text-book [20 48]. The Aphids that he collected comprise at least ten and possibly 13 species, of which only *A. fabae* is polyphagous. Their principal morphological characters are given in a table, and outstanding problems relating to *A. fabae* are discussed.

Börner and Janisch divided the Aphids that overwinter on *Euonymus* into the short-haired *A. euonymi*, F., which occurred on *Rumex crispus*, *Solanum nigrum* and *Polygonum convolvulus*, and the long-haired *A. fabae* (*papaveris*, F.), which did not [10 505]. They stated that *A. fabae* was not found on *Rumex* spp., and could not be induced to breed on them, but Franssen includes *R. crispus*, *R. domesticus*, *R. hydrolapathum* and *R. obtusifolius* among its food-plants [cf. 15 465], and Jones in England found that it readily colonised *R. obtusifolius* [31 68]. The question therefore arises whether the Aphid known as *A. fabae* in Britain represents one or two species. Furthermore, there is a nomenclatorial problem, since evidence is given that *A. euonymi* may be the species subsequently described as *A. cognatella*, Jones [32 17], in which case another name is required for the short-haired species described by Börner, Janisch and Franssen.

Börner considers that *A. fabae* overwinters only on *Euonymus*, but Lambers regards *A. philadelphi*, Börn., which lives on *Philadelphus* spp., and is transferable to *Euonymus* spp., *Viburnum* spp., and various weeds, and *A. mordwilкови*, B. & J., which overwinters on *Viburnum opulus* and migrates to *Arctium* spp. in spring as specialised races of this species, and Franssen includes *P. coronarius*, *Deutzia crenata* and *V. opulus* among its winter food-plants in Holland [15 465]. Black Aphids occur on all these plants in England, and *A. fabae* is known to occur on *V. opulus*. Another important problem is the part played in the infestation of summer crops by the black Aphids that overwinter as parthenogenetic colonies on *E. japonicus* in some seasons and on winter or self-sown beans in south-western England. Field observations suggest that a distinct race of *A. fabae* may occur on *Cirsium arvense*, which is frequently uninfested when beans and beet are attacked and infested when they are not. Migrants arrive on it at the same time as on beans and beet and are indistinguishable. It has been shown that *A. fabae* is not readily transferable to *C. arvense* [cf. 31 68].

SCHIMITSCHEK (E.). **Beiträge zur Forstentomologie der Türkei III. Die Massenvermehrung des *Ips sexdentatus* Börner im Gebiete der orientalischen Fichte. (I Teil.)** [Contributions to the Forest Entomology of Turkey III. The Outbreak of *I. sexdentatus* in the Region of the Oriental Spruce. First Part.]—*Z. angew. Ent.* **26** pt. 4 pp. 545-588, 25 figs. Berlin, 1939.

The second part of this paper on the outbreak of *Ips sexdentatus*, Börn., on oriental spruce (*Picea orientalis*) in the region of Trebizond, has already been noticed [R.A.E., A **30** 164]. In this first part, the bionomics of the Scolytid and the causes of the outbreak are discussed. A detailed description is given of the soil, rock formation, and climate of the three affected localities, and of the composition of the forests in which observations were made. Spruce trees over nearly 10 sq. miles had been destroyed by 1938, but *Pinus sylvestris*, which is attacked in other regions, was not infested.

There are normally two generations and a partial third in the year, and young adults and some larvae overwinter. The first flight occurred in April and May, the second in July and early August and the third in October. Primary attacks on healthy trees, which were initiated by females of all generations, were usually confined to the upper parts of the trunk; many of the beetles were drowned by a flow of resin as they bored in, but the tree was weakened and was unable to resist subsequent attack in any part of the trunk. Infestation caused the needles to turn red, and all the reddened needles fell in winter. The discoloration spread in proportion to the amount of damage to the cambial zone; after several attacks, the whole crown was sometimes affected and the tree ultimately died. It was observed that the discoloration spread more slowly in shady than in sunny positions. The brood galleries were sometimes more than 20 ins. long, and the feeding galleries of the larvae extended at right angles to them for up to about 5 ins. Further injury was caused by the tunnelling of females that had oviposited (regeneration feeding), which sometimes occurred in trees other than those in which they had oviposited and was sometimes followed by the construction of fresh brood galleries, again in other trees; by the feeding of the newly emerged adults (maturation feeding), which occurred not only in the trees in which they had developed but also in others; and by that of adults seeking shelter for overwintering. The sapwood was injured in all cases, and most deeply by the overwintering adults. Since trees attacked by *I. sexdentatus* develop blue rot, caused probably by species of *Ceratostomella*, while others do not, it is concluded that the insect is a vector of the fungus.

The severity of the outbreak is attributed to climatic conditions favourable to the development of the beetle, indiscriminate felling, and failure to apply adequate measures of prevention and control, such as the removal of dead, injured or infested trees and the barking of logs.

[BEI-BIENKO (G. Ya.), BOGDANOV-KAT'KOV (N. N.), IL'INSKIĬ (A. M.), FAL'KENSHTĖIN (B. Yu.) & SHCHEGOLEV (V. N.).] Бей-Биенко (Г. Я.), Богданов-Катьков (Н. Н.), Ильинский (А. М.), Фалькенштейн (Б. Ю.) и Щеголев (В. Н.). *Agricultural Entomology*. [In Russian.]—9×5 $\frac{3}{4}$  ins., 648 pp., 289 figs. Moscow, OGIZ, 1941. Price 14 rub. 30 kop.

This text-book, which has been edited by V. N. Shchegolev, deals with insects, mites, nematodes and slugs that attack cultivated plants in the Soviet Union, and has a concluding chapter on rodents. The subjects of the first of the two parts into which it is divided include the loss of crops caused by various pests, the structure and classification of insects, the ways in which they breed and develop, factors that affect their distribution and the occurrence and termination of outbreaks, and, in a final section (pp. 156–264) agricultural, biological, chemical and mechanical control measures, and the composition, properties and methods of application of stomach and contact insecticides and fumigants. The second part comprises notes on the appearance, distribution, bionomics and control of individual pests. Separate chapters are devoted to polyphagous pests, those that attack particular crops or groups of crops, and those that infest stored products, and each opens with a discussion of the types of injury caused and the relative importance of the pests concerned.

[RUICHIN (Yu. V.).] Рычин (Ю. В.). *Pests of Vegetable Crops and their Control*. [In Russian.]—67 pp., 32 figs., 38 refs. Moscow, Gos. Izd. "Sovetsk. Nauka," 1942. Price 1 rub. 30 kop.

The subjects of this booklet for growers of vegetables in the Soviet Union include the structure and development of insects, the causes of outbreaks, general measures of prevention and control, the uses of common insecticides, spraying and dusting equipment, biological control, and the appearance, bionomics and control of a number of the commoner pests of vegetables, recorded under their popular names only.

[CHUGUNIN (Ya. V.) & YUGANOVA (O. N.).] **Чугунин (Я. В.) и Юганова (О. Н.). A Guide to the Control of Pests and Diseases of the Orchard.** [*In Russian.*].—68 pp., 1 pl., illus. Simferopol', Izd. "Krasn. Kruim," 1945. Price 5 rub.

This popular booklet was compiled to assist fruit-growers in the Crimea in the work of controlling orchard pests, many of which had multiplied unchecked during the war, so that the fruit crop was the worst on record. The greater part of it consists of notes on the bionomics and control of 24 species of insects infesting fruit trees. Only their popular names are given. The second part deals with fungi that attack fruit trees, and the third with the preparation and use of insecticides and fungicides and spraying technique.

[BEĬ-BIENKO (G. Ya.).] **Бей-Биенко (Г. Я.). Pests of agricultural Plants of the Province of Molotov.** [*In Russian.*].—131 pp., 27 figs., 40 refs. Molotov, OGIZ, 1946. Price 6 rub.

This survey of the insects and a few other invertebrates that attack cultivated plants of all kinds in the Province of Molotov, is based on the literature and the author's own observations in 1943-44. An outline of the natural and agricultural conditions of the Province is followed by a general account of the invertebrates there that are injurious to plants. The fauna of injurious insects and the bionomics of some of the pests are similar to those observed in the Province of Leningrad (which is at about the same latitude), so that data obtained there might be applicable to the Province of Molotov. The Halticid, *Psylliodes affinis*, Payk., which has not been recorded as of any particular importance from other parts of the Russian Union, is a major pest of potatoes there. The greater part of the book consists of notes on the local distribution, seasonal occurrence, economic importance and in some cases control of the various pests, which are arranged under the kinds of plants they attack. A key is given to those that are injurious as larvae, based on the characters of the larvae, the food-plant and the type of injury caused.

[CHESNOKOV (P. G.).] **Чесноков (П. Г.). Pests of Field and Vegetable Crops.** [*In Russian.*].—69 pp., 30 figs. Sverdlovsk, OGIZ, 1944. Price 1 rub. 30 kop.

This popular handbook deals with pests (chiefly insects) of field crops and vegetables in the Province of Sverdlovsk, in the region of the Ural mountains. About half of the matter comprises general information on the morphology, habits and importance of the three chief groups of pests, namely rodents, insects and mites, agricultural, mechanical and chemical methods of controlling them, spraying and dusting apparatus, and biological control, and much of the remainder consists of notes on the appearance, bionomics and control of individual insects. Only the popular names of pests are used.

[MISHCHENKO (A. I.).] **Мищенко (А. И.). Insect Pests of Field and Vegetable Crops of the Far East.** [*In Russian.*].—8vo, 194 pp., 104 figs. Khabarovsk, Dal'giz, 1940. Price 6 rub. 30 kop.

This is the first published survey of the insects that attack field and vegetable crops in the Russian Far East. Introductory sections on the morphology, bionomics, classification and control of insects, and on insecticides and equipment for applying them are followed by others in which the pests are arranged systematically under the crops attacked, and notes are given on their bionomics and the appearance of the injurious stages. Each of the latter sections contains a key to the species concerned based on the type of injury caused.

[EFIMOV (A. L.).] **Ефимов (А. Л.). A Reference Book on the Use of Poisons for the Control of Pests and Diseases of agricultural Plants.** [In Russian.]—96 pp. Moscow, OGIz, 1943. Price 3 rub.

This booklet contains eleven sections, of which the first six deal, respectively, with sprays, dusts and poisoned baits for the control of chewing insects; sprays and dusts for the control of sucking insects and mites; banding adhesives and chemical treatment of bands; fumigants for treating soil, plants, buildings and stored products; sprays for treating empty storehouses and granaries; and dusts for treating grain infested with insects or mites. Three further sections on the control of rodents and plant diseases and the disinfection of soil, packing material and buildings, are followed by two on the toxicity of the various preparations, precautions to be adopted during their transport, storage and use, and the treatment of cases of poisoning.

[REKK (G. F.).] **Рекк (Г. Ф.). Mites injurious to cultivated Plants.** [In Russian.]—96 pp., 33 figs., 21 refs. Tbilisi [Tiflis], Izd. Akad. Nauk Gruz. SSR, 1941. Price 6 rub.

This survey of the more important mites that are injurious to cultivated plants in various parts of the world is divided into two parts. In the first (pp. 7-24), notes are given on the structure and biology of mites and the collection and preparation of specimens, together with a key to the nine families that include phytophagous species. The second part (pp. 25-85) contains sections, each of about 20 pages, on the Tetranychids and gall-mites (Eriophyids and Phyllocoptids), and notes on the morphology and habits of the adults of the other families and the distribution and food-plants of some of the phytophagous species. Keys are given to the genera of the Tetranychids and the species of some of them, with information on their morphology, food-plants, distribution, and in some cases bionomics. In the case of the gall-mites notes are given on their morphology and bionomics in general and the types of leaf-galls formed by them, together with a key to the genera, and lists of species showing their food-plants.

SLOAN (W. J. S.). **Migrations of the Corn Ear Worm.**—*Qd agric. J.* **61** pt. 5 pp. 272-274. Brisbane, 1945.

Migrating bands of larvae of *Heliothis armigera*, Hb. [cf. R.A.E., A **31** 343] are well known in the Callide Valley of Queensland, where they sometimes damage many acres of cotton. The migrations may occur at any time during spring, summer or autumn, and sometimes more than once in a season, but are most usual in December or January. Occasionally, large numbers of larvae of *Loxostege affinitalis*, Led., also take part [cf. **25** 348]. The main damage is to the squares, flowers and bolls of cotton, but seedlings are sometimes completely destroyed and larger plants deformed.

The migrations originate on crops or weeds outside the cotton field or on weeds in the field itself, and have become less frequent as methods of cultivation in the Valley have improved. They are caused by lack of suitable food in dry weather, disturbance by parasites and predators, or by such farming operations in adjacent fields as the destruction of weeds or the cutting or grazing of a heavily infested crop of lucerne. When any one section of the invading band, which usually consists of fourth instar and older larvae, encounters a suitable crop on which to feed, there is a tendency for the rest of the band to converge upon it. The smaller larvae usually remain in the original breeding-ground.

Susceptible crops should be planted at a distance from potential sources of migration, if it is not possible to eliminate these altogether, and they can be protected from invasion by furrows [cf. **27** 390] along which a bait of 1 lb. Paris green, 2 quarts molasses and 25 lb. bran moistened with about 2½ gals.

water has been scattered. If the soil is unsuitable for furrows, the bait should be spread, at the rate of 50 lb. dry bran per acre, over a 20-foot strip between the crop and the advancing swarm. If the cotton crop has been invaded, a spray containing lead arsenate and molasses [31 30] should be applied to the affected area and the surrounding 20-foot strip at the rate of 8-30 gals. per acre, according to the size of the plants. Two applications may be necessary in the case of a heavy infestation. Succulent weeds dipped in this spray and arranged in layers 6 inches high in front of the invading larvae may be used as a poison barrier.

LEVER (R. J. A. W.). **Annual Report of Entomologist for 1944.**—*Agric. J. Fiji* **16** no. 3 pp. 87-88. Suva, 1945.

This report includes lists of insect pests that were injurious in Fiji during 1944, some of which have already been noticed [*R.A.E.*, A **34** 101]. Those of major importance include *Cirphis unipuncta*, Haw., *Spodoptera mauritia*, Boisd., and *Marasmia venialis*, Wlk., on rice, *Prodenia litura*, F., on tobacco, dalo [*Colocasia*] and pumpkin, *Margaronia indica*, Saund., and *Leptoglossus australis*, F., on pumpkin, *Dysdercus insularis*, Stål, on cotton, and *Graeffea crouani*, Le Guillou, on leaves of coconut [cf. **20** 722]. Pests of less importance included *Agrotis ypsilon*, Hfn., on potato, *Gnorimoschema (Phthorimaea) operculella*, Zell., on tobacco, and *Ephestia cautella*, Wlk., and *Corcyra cephalonica*, Staint., in stored rice. In the course of work on the biological control of noxious weeds, consignments of *Liothrips urichi*, Karny, were sent to Vanua Levu, Tailevu and Naitamba Island for release against *Clidemia [hirta]*, and *Teleonemia scrupulosa*, Stål, was sent to Rotuma Island against *Lantana*. Rearing of *Syntomosphyrum (Melittobia) indicum*, Silv., was continued [33 291], and 29,300 examples were released against fruit-flies during the year; *Microphanurus basalis*, Woll., was recovered from eggs of *Nezara viridula*, L., in the field [cf. **32** 167; **33** 291, etc.]. *Plaesus javanus*, Erichson, continued to give good control of the banana borer, *Cosmopolites sordidus*, Germ., in Tahiti [cf. **33** 202]. *Aonidiella aurantii*, Mask., was intercepted on lemons from New South Wales.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **16** no. 3 pp. 88-90, 8 refs. Suva, 1945.

*Cyrtorhinus mundulus*, Bredd., which was thought not to occur in Fiji [cf. *R.A.E.*, A **34** 101], has recently been found there feeding on the eggs of *Perkinsiella vitiensis*, Kirk., on sugar-cane. The Pteromalid, *Pachycrepoides dubius*, Ashm., is also recorded for the first time in Fiji, where it was reared from pupae of *Dacus passiflorae*, Frogg., *Musca domestica*, L. [vicina, Macq.] and *Sarcophaga* spp. Its development lasts 16-17 days. The stomach contents of three adults of *Bufo marinus*, which was introduced into the British Solomon Islands Protectorate in 1940, were examined on two islands there in August 1945; five insects and 12 snails (*Subulina*) were found in two, both on one island, and nine insects in the third. One of a series of consignments of *Scolia ruficornis*, F., sent from Zanzibar to Samoa by air for release against *Oryctes rhinoceros*, L., passed through Fiji.

FULTON (H. G.) & GLENDENNING (R.). **The Tuber Flea Beetle in British Columbia and its Control.**—*Process. Publ. Div. Ent. Dep. Agric. Can.* no. 48, 4 pp. [Ottawa] 1946.

*Epitrix tuberis*, Gentner, has caused increasing injury to potato tubers on the lower mainland of British Columbia since 1940, and similar injury has recently been observed on Vancouver Island and the interior of the Province [cf. *R.A.E.*, A **35** 13]. *E. subcrinita*, Lec., which feeds only on the leaves [cf. **32** 358] is

also present. *E. tuberis* is confined almost entirely to potato, tomato and other solanaceous plants, though the adults occasionally feed on bean foliage, and its life-cycle lasts about six weeks [cf. **32** 359]. The larvae are active in late June and early July, and again, in districts or seasons in which a second generation occurs, in August and September. Experiments over four years have shown that the adults can be controlled by dusts of calcium arsenate and lime (1 : 4), cryolite and talc (1 : 3) or 3 per cent. DDT, which are about equally effective. Early potatoes planted in March and lifted early in July will probably be only lightly infested, and one or two applications in the first half of June will be sufficient. Main-crop potatoes require 5-7 applications at intervals of 10 days, beginning in mid-June, when the plants are 3 ins. high. Later-planted crops require fewer applications unless adults appear again in August. Where late blight [*Phytophthora infestans*] occurs, a spray of 5 lb. calcium arsenate or 2 lb. wettable DDT powder (50 per cent. DDT) in 100 gals. Bordeaux mixture or a dust containing 20 per cent. calcium arsenate or 25 per cent. cryolite in a copper fungicide is recommended. More insecticide should be applied to the edges of the field than to the centre, as the beetles are more numerous there.

SORENSEN (C. J.). **Mirid-bug Injury as a Factor in declining Alfalfa-seed Yields.**—5th Ann. Fac. Res. Lect., 26 pp., 10 refs. Logan, Utah, Utah St. agric. Coll. Fac. Ass., 1946.

Mirids of the genus *Lygus* are the most important of the insects responsible for the decreased yields of lucerne seed in Utah of recent years, the species concerned being *L. hesperus*, Knight, and *L. elisus*, Van D., which are the commonest, and *L. oblineatus*, Say, which is not frequent. In this lecture, the author discusses their distribution, morphology, wild food-plants, bionomics and population density, the type of damage that they cause and their control [cf. R.A.E., A **29** 567; **31** 337; **33** 101, etc.]. Following successful tests with DDT and sabadilla dusts in 1944 [**34** 260, 261], further experiments were made in 1945 with dusts of 5 per cent. DDT, 3 per cent. DDT in sulphur, and 20 per cent. sabadilla. The *Lygus* population in the experimental plots was relatively low, owing to their isolated situation, careful cultivation and rather thin crop; consequently only one application of the insecticides was made, on 3rd July, just before the appearance of the first blossoms. The yields of recleaned seed from the different plots varied from 96 to 556 lb. per acre, but there was no significant difference resulting from the application of insecticides, though the yields generally varied inversely with the numbers of *Lygus*. Mean differences in *Lygus* numbers for the two DDT treatments were highly significant as compared with the untreated controls, but the difference for sabadilla was significant at the 5 per cent. level only.

The same materials were also applied once at the rate of 20 lb. per acre by means of a machine provided with a 20-foot canvas trailer to a commercial field of lucerne grown for seed. The stand was 2-4 years old, and was planted in 18 in. rows. The tests were made on second growth lucerne after the first crop had been cut for hay, and the *Lygus* population on the untreated plots averaged 5.16 bugs per sweep with a 15-inch net during the fruiting period. The reductions in *Lygus* numbers by all treatments were highly significant, but the difference between the DDT treatments was not significant. The mean seed yield on plots dusted with 5 per cent. DDT was 6.48 times as great as on the untreated controls, which was highly significant. The increase in yield on plots treated with 3 per cent. DDT in sulphur was significant, but not that on plots treated with sabadilla.

Information is also included on *Adelphocoris superbus*, Uhl., another Mirid that injures lucerne in the same way as *Lygus* spp. [cf. **20** 679; **33** 101]. Its distribution in the western United States is reviewed, and it is stated that no alternative food-plants are known in Utah. Observations showed that it

overwinters in the egg stage, the eggs being laid singly but close together in the stems, branches, leaves and petioles of lucerne. The earliest hatching in the Cache Valley, Utah, occurred on 5th May, and oviposition took place from mid-June to mid-September, the preoviposition period averaging 9 days in July. The average incubation period of 433 eggs under observation during July and August was 21.5 days, and the nymphal stage lasted 26 days in rearing cages. It seemed likely that there are two generations a year in Utah. The numbers of this bug have become much reduced in recent years because very little first-growth lucerne is now kept for seed, and as few individuals have reached the adult stage by the time the first-growth lucerne is cut, the eggs and nymphs are destroyed. No natural enemies of *A. superbis* are known. Overwintering eggs can be destroyed by close cutting and pasturing.

PATTON (R. L.). **Insect Damage to Nylon.**—*J. econ. Ent.* **38** no. 5 pp. 522–523, 1 ref. Menasha, Wis., 1945.

In view of reports of damage to finished nylon hosiery by larvae of one or more species of carpet beetle in a New York finishing mill, investigations were carried out to determine the factors that make this material attractive to such insects. Tests were carried out with larvae of *Anthrenus verbasci*, L., *A. vorax*, Waterh., *Attagenus piceus*, Ol., and the clothes moth, *Tineola biselliella*, Humm. The first was the most injurious, but all caused some feeding damage. Samples of the various treated fabrics were exposed to feeding by 1–20 larvae for 1–4 weeks at 28°C. [82.4°F.]. The fabrics tested included old and new finished nylon, unfinished but knitted nylon, a rough cloth woven from sized nylon yarn, a fabric woven from dry nylon, cotton muslin and cotton gauze, and the finishing materials included a polyvinyl alcohol size and the scours two sulphonated oils and a sulphated alcohol, all used according to the commercial procedures.

It was found during a test that lasted ten days that active larvae of *Anthrenus verbasci* preferred finished nylon to brown wool cloth when both were equally accessible, 6 out of 12 feeding on the nylon and none on the wool. In a starvation test carried out under conditions similar to those that might be expected in a warehouse, one larva made 40 holes in a piece of clean nylon two inches square during an exposure of ten days. Further tests showed that scoured nylon was more attractive than dry or sized nylon; samples of cotton treated in the same way showed the same results. A scour containing a sulphonated oil and sodium silicate imparted the greatest attraction, followed by the sulphated alcohol. No damage was observed on any fabric woven from dry nylon. The larvae do not digest the eaten nylon, although it is possible that they can acquire a small amount of nourishment from it. Olfactory tests showed no indication that the insects respond to olfactory stimulation in the search for food, and measurements of the respiratory quotient were too erratic to show the nature of the food being metabolised by them. The tactile senses appear to be of great importance in the selection of food, so that the finish imparted to the fibre is probably the critical factor.

DETHIER (V. G.). **The Transport of Insects in Aircraft.**—*J. econ. Ent.* **38** no. 5 pp. 528–531. Menasha, Wis., 1945.

In the course of investigations in central Africa from December 1943 to April 1945 on the number and kinds of insects inadvertently transported in aeroplanes, specimens were collected from the interior of aircraft at various landing points between India and the west coast of Africa, usually immediately after arrival and where possible before the removal of cargo. Since the interior of the aeroplanes was sprayed before landing, the insects taken were all dead or dying. Engine nacelles were searched at the same time and wing

and tail spaces during major maintenance operations. As the route investigated supports a very uniform and continuous Arthropod fauna, geographical locality had little effect on the composition of the samples collected, and the four most important factors concerned were the habits of the insects, the immediate environment in which the aeroplane had been parked, the ratio of population density of each species to the total population in the environment, and the season. Over 2,000 insects of at least 210 species were collected, mostly in the cabins. Of these, 88.5 per cent. were Diptera, mostly Muscids, 3.1 per cent. Hemiptera, 3 per cent. Hymenoptera, 2.8 per cent. Coleoptera, 1.45 per cent. Orthoptera, 0.6 per cent. Lepidoptera, and 0.55 per cent. other orders. No insects were recovered from the engine nacelles in which dust, oil and grease exert some repellent effect, and test flights with caged mosquitos indicated that any that entered them would not survive the journey. Mortality apparently occurred during the take-off. One species of Muscid was found in the wing and tail spaces, but there is little likelihood of escape from these. There was no indication that insects entered flying aircraft.

It was found that the incidence of insects in aeroplanes could be decreased by sanitation, including the control of mosquitos at airports, and by using cleared areas away from the edges of jungles, fields and watercourses as parking places. Along the route studied, control measures in aircraft can safely be restricted to the cabin; the use of aerosol bombs has proved adequate.

STEVENSON (W. A.). **DDT compared with other Insecticides for Control of Hemipterous Insects on Cotton.**—*J. econ. Ent.* **38** no. 5 pp. 531–533, 4 refs. Menasha, Wis., 1945.

The principal Hemiptera that attack cotton in Arizona are the Pentatomids, *Euschistus impictiventris*, Stål, *Chlorochroa sayi*, Stål, and *Thyanta custator*, F., and the Mirids, *Creontiades femoralis*, Van D., and *Lygus* spp.; *Adelphocoris superbus*, Uhl., and several other species are of minor importance. Since DDT dusts gave a high mortality of Pentatomids and Mirids in cage tests in 1943–44 [cf. *R.A.E.*, A **32** 379], they were compared with the dusts of sulphur and arsenicals previously recommended in field experiments in three localities in Arizona in 1944.

In a test in which applications were made with a rotary hand-duster at approximately weekly intervals from 30th June to 19th August, two applications of 2 per cent. DDT in pyrophyllite followed by five of DDT, sulphur and pyrophyllite (4 : 60 : 36) at the average rate of 30 lb. per acre were compared with seven applications of dusts of Paris green and sulphur (7.5 : 92.5 and 15 : 85), basic copper arsenate and sulphur (33.3 : 66.7) and calcium arsenite and sulphur (10 : 90) at the average rate of 20 lb. per acre. All the treatments gave significant reductions of injurious insects and increased yields over no treatment, but DDT gave significantly better control and higher yields than any of the arsenicals. In one test of dusting by aeroplane, one application of 2 per cent. DDT in pyrophyllite and five of DDT, pyrophyllite and sulphur (4 : 36 : 60) were made at approximately weekly intervals from 11th July to 28th August at an average rate of 23.7 lb. per acre to a field infested chiefly by *Lygus* spp., of which *L. hesperus*, Knight, predominated. This treatment reduced the seasonal infestation by 57.3 per cent. and increased the yield of seed cotton from 946 to 1,866 lb. per acre; three applications of Paris green and sulphur (7.5 : 92.5) resulted in a yield of 1,348 lb. per acre. In another, a dust of 2 per cent. DDT in pyrophyllite, applied once on 26th August at 30 lb. per acre to a field in which the injurious insect population was very low, caused a slight reduction in the number of injurious Hemiptera and an insignificant increase in yield. In tests with a power dusting machine, two applications of 2 per cent. DDT in pyrophyllite, followed by three of DDT, pyrophyllite and

sulphur (4 : 36 : 60) and two of 5 per cent. DDT in pyrophyllite were compared with seven of 7.5 per cent. Paris green in sulphur or 1 per cent. dinitro-o-cresol in a Friarite (volcanic ash). Applications were made at approximately weekly intervals between 28th June and 9th August, at about 15 lb. per acre except for the 5 per cent. DDT, which was used at 30 lb. per acre. The injurious Hemiptera migrated into this field early, and throughout the growing season. The insecticides were less effective in reducing the insect populations in this test than in the others, but the DDT was slightly more effective than the other insecticides. It caused 22 per cent. increase in yield as compared with 15.8 per cent. for Paris green and sulphur, and a slight reduction for dinitro-cresol.

IVY (E. E.), PARENIA jr. (C. R.), MORELAND (R. W.) & EWING (K. P.).  
**DDT for Bollworm Control during 1944.**—*J. econ. Ent.* **38** no. 5 pp. 534–536, 3 refs. Menasha, Wis., 1945.

The value of DDT against larvae of *Heliothis armigera*, Hb., on cotton, indicated by laboratory tests in 1943 [*R.A.E.*, A **32** 378], was confirmed in cage and field tests carried out in Texas in 1944 with 10 per cent. DDT in pyrophyllite, diluted with pyrophyllite for use as a dust or applied in an aqueous suspension. In the first of a series of cage tests with third-instar larvae, a dust containing 4 per cent. DDT used at the rate of 16 lb. per acre was more effective than basic copper arsenate and sulphur (1 : 1) at the same rate or cryolite (88.2 per cent. sodium fluoaluminate), lead arsenate or calcium arsenate at 8 lb. per acre. In the second, dusts containing 4 and 2 per cent. DDT at 16 lb. per acre were more effective than calcium arsenate at 8 lb., but those containing only 1 and 0.5 per cent. DDT were much less so. In the third, dusts containing 1, 2, 4 and 8 per cent. DDT applied at 32, 16, 8 and 4 lb. per acre, respectively, so that 0.32 lb. DDT was applied per acre in each case, were effective in the order given and all were more effective than calcium arsenate at 8 lb. per acre. In the fourth, a mixture of 4 per cent. DDT (and 36 per cent. pyrophyllite) in calcium arsenate was slightly more effective than 4 per cent. DDT in pyrophyllite and much more so than one of calcium arsenate and pyrophyllite (60 : 40), all at 16 lb. per acre. In the fifth, 100 per cent. mortality was obtained with a spray applied to give 1.28 lb. DDT per acre and approximately 90 per cent. with a spray and a 4 per cent. dust, both applied to give 0.64 lb. When sprays and dusts were applied four times at the last rate at intervals of five days, the residual effect against first- and third-instar larvae after 0.46 inch of rain had fallen was greater for the spray than for the dust.

In tests in small field plots, dusts of 1, 2, 4 and 8 per cent. DDT of undiluted calcium arsenate were applied on 2nd, 7th and 9th August, but the second application was followed by rain within 24 hours. All plots were dusted lightly with an arsenical on 9th August and 1st September to control *Alabama argillacea*, Hb., which was not controlled by DDT, and with nicotine on 19th September against *Aphis gossypii*, Glov., which increased on plots dusted with DDT or calcium arsenate. Injury by *H. armigera* to bolls was reduced significantly by all the treatments, and that to squares by all but 1 per cent. DDT. There was no significant difference in square injury between 8 per cent. DDT and calcium arsenate, but the former was significantly better than 4 per cent. DDT, and both better than 2 or 1 per cent. DDT; 8 per cent. DDT was not significantly better than any other treatment except 1 per cent. DDT in reducing boll injury. There was no significant difference in yield between treatments, but both 8 and 4 per cent. DDT and calcium arsenate produced significantly more seed-cotton than no treatment.

In a large-plot test, the dusts to be tested were applied four times at approximately five-day intervals between 26th July and 10th August, and an arsenical

dust was applied lightly to the control plot on 9th August and to the DDT plot on 16th August to control *Alabama argillacea*. Neither *Anthonomus grandis*, Boh., nor *Psallus seriatus*, Reut., was abundant enough to cause noticeable damage, but infestation by *H. armigera* was rather heavy. Calcium arsenate at 15 lb. per acre, a mixture of lead and calcium arsenates (36.4 per cent.  $\text{As}_2\text{O}_5$  and 31.6 per cent.  $\text{PbO}$ ) at 12 lb. per acre and 4 per cent. DDT at 16 lb. per acre all reduced the injury to squares and bolls; they increased the yield from 1,104 lb. seed cotton per acre to 1,792, 1,680 and 1,840 lb. per acre, respectively. In all cases the mixture of DDT and pyrophyllite was applied satisfactorily by the dusting machines used and caused no injury to the cotton.

ANDERSON (R. F.). **DDT and other Insecticides to control the Saratoga Spittle Insect on Jack Pine.**—*J. econ. Ent.* **38** no. 5 pp. 564–566. Menasha, Wis., 1945.

The results are given of preliminary investigations carried out in 1944 on insecticides for control of the adults of *Aphrophora saratogensis*, Fitch, which have severely injured many young pine stands in the Lake States since 1940 [*cf.* *R.A.E.*, A **33** 107]. As the insecticides could not be applied directly to the insects, owing to their habit of jumping away at the least disturbance, they were applied to young pines (*Pinus banksiana*) scattered among untreated trees, so that the insects would subsequently come into contact with them. Two weeks after treatment, the number of adults was reduced by 95 per cent., as compared with the controls, on trees that received a spray containing 1 per cent. DDT; by 87, 48 and 8 per cent., respectively, on those that received sprays of dry powdered Bordeaux mixture (4.8 and 2.4 per cent.) and lime-sulphur (2.4 per cent.); and by 64 and 51 per cent. on those dusted with hydrated lime alone and with sabadilla dust (80 : 20). The pines were 5–10 ft. high, and about 1 U.S. quart spray or 8 oz. dust was applied per tree. The DDT spray was prepared by emulsifying xylene containing DDT in water with sodium lauryl sulphate; the amount of xylene was sufficient to dissolve only about 66 per cent. of the DDT, but the remainder formed a good suspension when worked into the water. The residual effect of this spray was such that it reduced the numbers of adults by 89 per cent. eight weeks after it was applied, when the observations ceased. Counts of the dead insects that fell on trays beneath the trees showed that many individuals stayed on the sprayed trees long enough to receive a lethal dose of DDT.

To obtain more information on the possible repellent effect of the treatments, branches from treated trees were caged with field-collected insects. The percentages dead after 24 and 48 hours were 96 and 100 for the DDT spray, 97 and 100 for the dust of sabadilla and lime, 62 and 91 for hydrated lime alone, 14 and 32 for 4.8 per cent. Bordeaux mixture, and 9 and 22 for 2.4 per cent. lime-sulphur, as compared with 4 and 8 on untreated branches. The DDT deposit had been exposed to weathering for about seven weeks, but the other insecticides were freshly applied before each test. The low toxicity of the Bordeaux mixture suggested that the good results obtained with it in the field test were due to repellence. When the insects were caged with one treated and one untreated branch, the percentages dead after 24 hours were 38 for DDT and the sabadilla mixture and 10 for hydrated lime, indicating that all three had some repellent effect. After the treated branches had been continuously exposed to weathering, only DDT retained a high degree of effectiveness. The mortalities of insects that were enclosed for 5, 15, 30 and 60 minutes in a cage that had been sprayed with 1 per cent. DDT and exposed to the weather for 30 days were 22, 36, 72 and 64 per cent. after 24 hours and 41, 49, 78 and 83 per cent. after 48. Insects that were kept in the treated cage for two hours all died within 24 hours.

Re-examination of trees in 1945 showed that those treated with DDT, lime or Bordeaux mixture were in better condition than surrounding untreated trees.

EBELING (W.). **DDT and Rotenone used in Oil to control the California Red Scale.**—*J. econ. Ent.* **38** no. 5 pp. 556–563, 8 refs. Menasha, Wis., 1945.

LINDGREN (D. L.), LADUE (J. P.) & DICKSON (R. C.). **Laboratory Studies with Rotenone Oil in Sprays to control the California Red Scale.**—*T.c.* pp. 567–572, 3 refs.

The field experiments with sprays against *Aonidiella aurantii*, Mask., on *Citrus* in California described in the first paper have been noticed from another source [*R.A.E.*, A **34** 79].

The following is based on the authors' summary of the second paper. A laboratory method for the rapid and accurate determination of small differences in the effectiveness of oil sprays against adults of *Aonidiella aurantii*, Mask., is described, and the results obtained with three grades of oil, with and without various concentrations of derris extractives (30 per cent. rotenone) or of ground cubé root (4.3 per cent. rotenone), with various mutual solvents are given. The scales were reared and sprayed on grapefruits.

When derris extractives were incorporated into a light-medium spray oil, with n-butyl phthalate as mutual solvent, there was a progressive increase in the toxicity of the oil to the scale as the concentration of the derris extractives was increased from 0 to 0.7 per cent. Whether the oil used contained no solute and was emulsified in the tank with blood-albumin spreader or was an emulsive oil containing 1 per cent. glyceryl dioleate as emulsifier made no difference in the effectiveness of the spray, although the emulsive-oil spray deposited less oil on the fruits. Ground cubé root (200-mesh) soaked in a tank-mix oil or emulsive oil was about as effective as the derris extractives incorporated into the oil by means of mutual solvents [*cf.* *R.A.E.*, A **33** 350]. Mutual solvents that reduced the oil-depositing efficiency of the spray also reduced its insecticidal effect [*cf.* **32** 220]. When 2-(4-tertiary-butylphenoxy) ethanol was used, the spray was less effective than oil alone, despite the addition of derris extractives. When the derris extractives were dissolved in part of the required amount of mutual solvent at 110°C. [230°F.] and the remainder was added to cool the solution rapidly, they had no greater insecticidal effectiveness than when they were dissolved in the entire amount of mutual solvent at 60°C. [140°F.] and allowed to cool gradually.

Six months of ageing of derris extractives in n-butyl phthalate, di-isobutyl ketone and diamyl phenol caused some, very little and no reduction, respectively, in their insecticidal effectiveness. When the toxic ingredients of cubé root were extracted by soaking the root in light-medium emulsive spray oil, no reduction in effectiveness was caused by six months of ageing. Soaking the ground cubé root in the oil for 12 hours appeared to result in complete extraction of the toxic ingredients, for more prolonged soaking resulted in no further increase in toxicity. When the cubé root was added directly to the oil spray in the spray tank, the insecticidal effectiveness of the spray was not so great as when it was stirred into the oil before this was poured into the spray tank.

BERGER (B. G.). **Food Preferences of the Firebrat.**—*J. econ. Ent.* **38** no. 5 pp. 577–582, 3 figs., 2 refs. Menasha, Wis., 1945.

In a room in Illinois heavily infested with *Thermobia domestica*, Pack., it was found that unbaited traps in suitable positions caught more examples of this Lepismid than less favourably placed ones containing food, thus indicating that it is not attracted from a distance by food, and that poisoned food for its control should be exposed where it is seen or is likely to breed. Experiments

were therefore carried out by a technique that is described to determine whether it is capable of food selection, and details are given of the results obtained with 138 different foods or combinations of food. It was shown that it is capable of selection among foods equally available and a number of foods or combinations of food were found to be attractive. Sugar increased the attractiveness of some baits, but salt did not improve that of flour. A combination of certain baits proved more attractive than any of the component parts, and a mixture of wheat flour and powdered sugar (85:15) appeared to be the most practical because of its availability and ease of mixing.

CHAPMAN (A. J.) & MORENO (I.). **Further Observations on Host Plants of the Pink Bollworm in the Lower Rio Grande Valley of Texas and Mexico.**—*J. econ. Ent.* **38** no. 5 pp. 583–584, 2 refs. Menasha, Wis., 1945.

Observations on secondary food-plants of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., in the lower Rio Grande Valley in Texas and Matamoros, Mexico, were continued in 1943–44 [cf. *R.A.E.*, A **32** 57, etc.]. The degree of infestation in these depended on the intensity of infestation in cotton, their proximity to cotton fields, and the time of year at which they bore fruit. The most favourable period for infestation of secondary food-plants is in autumn, when infestation in cotton is heaviest and cotton stalks are destroyed in the fields. The bollworm overwintered in cages in fruiting forms of *Malvariscus drummondii* and *Pseudabutilon lozani* collected in autumn, and adults emerged in spring, indicating that both these plants may serve as sources of infestation of cotton; larvae from eggs laid by moths that had developed on *P. lozani* infested cotton squares to which they were transferred. Bollworm larvae were also found in fruiting forms of *Hibiscus mutabilis* and in one of *H. cardiophyllus* in Texas, and in flowers of *M. arboreus* in Texas and Mexico.

USINGER (R. L.). **Biology and Control of Ash Plant Bugs in California.**—*J. econ. Ent.* **38** no. 5 pp. 585–591, 4 figs., 6 refs. Menasha, Wis., 1945.

The following is partly based on the author's summary. The Mirid, *Neoborus illitus*, Van D., is the most serious pest of ornamental ash trees (*Fraxinus velutina*) in California. It has one generation in the year. Near Davis, the eggs hatch when the first leaves appear (late February and early March), and the nymphs pass through five instars in about 25 days. Mating takes place about mid-April and the males die soon afterwards. The females oviposit in the stems of the current year's growth during April and May, and the eggs remain embedded in the plant tissue in a relatively undeveloped condition during the summer and autumn. They develop more rapidly and swell by absorption of water during the winter. *N. pacificus*, Van D., is less abundant on ornamental trees, but was found in two counties on *F. velutina* and Oregon ash [*F. oregona*]. Its life-cycle is similar to that of *N. illitus* except that the eggs are laid in the petioles or along the midribs of the leaves as well as in the woody tissue, and there is at least one additional generation before it disappears in July.

The nymphs feed first on the opening buds, and then on the new growth, causing white areas and black excrement spots on the leaves, followed by browning and curling. Stem feeding produces a condition of general wilting at the ends of the branches and finally a curling and drying of all new growth. The older nymphs and the adults feed on stems, leaves, seeds and male flowers, causing partial or complete defoliation, but after oviposition and the death of the bugs, new leaves are produced and the tree regains a superficially normal appearance during the summer months.

A spray containing 0.25 per cent. of the triethanolamine salt of 2,4-dinitro-ortho-6-cyclohexylphenol with 2 per cent. oil (viscosity 82, 76 per cent. unsulphonatable residue) and a wetting agent, applied on 30th January, gave

92 per cent. mortality of eggs, but another dinitro compound applied in February was ineffective. A western olefine base oil containing a spreader, 30 per cent. oleic acid and either 20 per cent. derris extract in camphor sassafras base oil (5 gm. rotenone per 100 cc.) or a pyrethrum extract applied at a concentration of 1 : 400, gave complete mortality of nymphs in March and the former also of adults in April, and the same oil with oleic acid and nicotine alkaloid and sprays containing lauryl thiocyanate, nicotine sulphate in oil, or butyl carbitol thiocyanate were also fairly effective against the nymphs in March. Sprays effective against the nymphs should preferably be applied soon after hatching is complete, when thorough coverage prevents further injury for the year and precludes it in the following year, because no eggs are laid. Good coverage was given by 10 U.S. gals. spray per tree when the trees were dormant and with 20 U.S. gals. after the foliage appeared.

STEINHAUS (E. A.). **Insect Pathology and Biological Control.**—*J. econ. Ent.* **38** no. 5 pp. 591–596. Menasha, Wis., 1945.

In this discussion of the importance and possible use of micro-organisms in the biological control of insects, the author points out that insect microbiology or insect pathology has been neglected, partly because entomologists are rarely adequately trained in microbiology, which includes the study of bacteria, fungi, protozoa, viruses and immunity, or microbiologists in entomology, and partly because initial reports on the value of such forms of biological control have frequently been over-enthusiastic and later results disappointing. He considers that attempts have been made to use micro-organisms without the fundamental research necessary to ascertain the various biological relationships that exist between them and insects, and that too little is known of the factors and potentialities concerned in the artificial use of micro-organisms in controlling insects or in encouraging the natural outbreak of disease.

In considering the ecology and bionomics of insects, the effect of disease on insect populations and the conditions that bring about the outbreak of disease in nature should not be ignored. Instances of natural epizootics cited include recent outbreaks in the western United States of undetermined diseases among *Acleris variana*, Fern., *Ellopiia fiscellaria lugubrosa*, Hulst, and *Colias eurytheme*, Boisd. Attempts at artificial control by means of diseases include the use of the bacterium, *Coccobacillus acridiorum*, against locusts, particularly species of *Schistocerca*, of the fungus, *Beauveria globulifera*, against the chinch bug [*Blissus leucopterus*, Say] and of certain protozoa and bacteria against the European corn borer [*Pyrausta nubilalis*, Hb.], which showed promise in early tests, but proved disappointing in later ones. In the first case the poor results were possibly due to variations in the susceptibility of different species of locusts and in the virulence of different strains of bacterium, and in others to a lack of precise understanding of the saturation point and other factors. Most work on natural control has been done with fungi, but interest in bacteria has been revived by the use of *Bacillus popilliae* and *B. lentimorbus* against *Popillia japonica*, Newm., in the United States. Protozoa should be useful in the artificial control of insects, as their habit of forming resistant spores or cysts should enable them to withstand unfavourable conditions and also make it relatively easy to distribute them, and, furthermore, once a protozoan, such as a microsporidian, comes in contact with the digestive tract of its host, it is very likely to invade the tissues. There are many instances in which virus diseases (wilts or polyhedral diseases) have been observed to destroy large infestations of destructive insects within a short time. Extensive natural epidemics have occurred among larvae of the gipsy moth [*Lymantria dispar*, L.], nun moth [*L. monacha*, L.], and other Lepidoptera, and virus diseases also affect beneficial insects, as in the case of sacbrood (a non-polyhedral disease) of bees and jaundice (a polyhedral disease) of the silkworm [*Bombyx mori*, L.].

Virus diseases have not, however, proved easy to establish. The possibility of using two organisms simultaneously or of using one kind of micro-organism during one stage of the insect's life-cycle and another at a subsequent one should not be overlooked.

The author concludes that insect pathology should be recognised as a distinct subject, that basic research should be carried out on the many factors concerned in the spread of diseases among insects in the field, and that a systematic search should be made for hitherto unknown diseases occurring naturally among insects, which may be put to practical use with the proper techniques.

FIFE (L. C.), CHAPMAN (A. J.) & MCGARR (R. L.). **Insecticides for Control of the Cotton Flea Hopper.**—*J. econ. Ent.* **38** no. 5 pp. 598–599. Menasha, Wis., 1945.

In tests carried out in Texas in 1944 on the control of *Psallus seriatus*, Reut., on cotton, a single application of 2.5, 5 or 10 per cent. DDT in pyrophyllite or of 5 per cent. DDT in sulphur at approximately 10–15 lb. per acre, early in the morning when the plants were wet and the air calm, was more effective against both nymphs and adults than one of sulphur, calcium arsenate or calcium arsenate and sulphur (1:2). The addition of calcium arsenate to DDT in pyrophyllite (40:5:55) did not increase the effectiveness of the latter. Although there was considerable reduction in the infestation within 24 hours of treatment with DDT, in all but one case the maximum reduction occurred after 4–6 days. Counts made 16 days after treatment showed that the nymphs were considerably less numerous on plants treated with DDT than on those treated with sulphur, on which they were almost as abundant as on untreated plants. DDT was effective against the adults for at least 9–13 days. Although 5 per cent. DDT gave somewhat better control than 2.5 per cent., the data indicated that the latter would be sufficient, but further experiments are needed to determine the best dosage and interval of application and the most desirable diluents [*cf. R.A.E., A* **34** 345].

GILMORE (J. U.), LEVIN (C.) & SMITH (T. E.). **Effect of Ferric Dimethyl Dithiocarbamate on Emergence of Tobacco Flea Beetles from Plant-bed Soil.**—*J. econ. Ent.* **38** no. 5 pp. 599–600, 4 refs. Menasha, Wis., 1945.

Since ferric dimethyl dithiocarbamate has been shown to be effective against *Peronospora tabacina* (blue mould of tobacco), and also to inhibit the feeding of certain beetles [*cf. R.A.E., A* **33** 180], investigations were carried out in North Carolina in 1943 and 1944 on its use against *Epitrix hirtipennis*, Melsh., and the fungus in tobacco plant beds [*cf. 32* 359]. The plots were uniformly inoculated with a viable suspension of conidiospores of the fungus, and either sprayed with 2 lb. ferric dimethyl dithiocarbamate per 100 U.S. gals. water, with or without the addition of 4 lb. calcium arsenate, or left untreated. The sprays were applied twice a week at a pressure of 125–150 lb. per sq. inch, as commonly recommended for blue-mould control. Cages each covering 1 sq. ft. soil were put in the plots in late May, before the adults appeared, and records were made of the numbers emerging. Both sprays gave highly effective control of the mould. The spray containing calcium arsenate reduced the emergence of flea-beetles by 84 per cent. in 1943 and 96 per cent. in 1944 and the other spray by 47 per cent. in 1943 and 82 per cent. in 1944. Seedlings treated with the spray containing calcium arsenate tended to grow more slowly than the others at first, but there was no significant difference in growth two months after transplanting.

EBELING (W.). **DDT for Control of the Grape Bud Beetle.**—*J. econ. Ent.* **38** no. 5 p. 600, 1 ref. Menasha, Wis., 1945.

Since the adults of the Eumolpid, *Glyptoscelis squamulata*, Crotch, which is a serious pest of grapevines in the Coachella Valley, California, hide under loose bark on the trunks of the vines during the day and feed on the buds at night [*cf. R.A.E.*, A **28** 344], investigations were carried out in 1945 on their control by applying DDT to the trunks and stakes over which they move from one position to the other. Sprays containing 4 oz. casein spreader and 5 or 10 lb. Gesarol AK-20 (20 per cent. DDT) or 5 U.S. gals. of a 4 per cent. solution of DDT in kerosene per 100 U.S. gals. water were applied to the entire vine and stake and dusts containing 5 and 10 per cent. DDT in talc to the trunks and stakes only. About 0.8 U.S. gal. spray and 0.1 lb. dust per vine were applied once to some plants and twice, at intervals of 21 and 12 days, respectively, to others during February and March. In a few tests the sprays or dusts were applied only to one side of the vine. All treatments that were made before the beetles were able to cause injury gave highly satisfactory control, even though the single treatments were made two weeks before they were necessary and were followed by two rainstorms that removed much of the DDT. In one vineyard, 90 per cent. of the buds were destroyed on untreated vines and only 1.7 per cent. on those receiving a single treatment with the 5 per cent. dust, and single spray treatments were no more effective, even though the whole vine was covered. Two applications of sprays or dusts resulted in practically complete protection of the buds.

SMITH (R. H.). **Thanite as a Control for Ants.**—*J. econ. Ent.* **38** no. 5 p. 604. Menasha, Wis., 1945.

Undiluted Thanite (a product described as a secondary terpene alcohol thiocyanyl acetate) atomised on nests of *Iridomyrmex humilis*, Mayr, in California eliminated all ants for several days, and invasions of ants into houses were invariably stopped immediately by Thanite applied in this way. A very thin smear of the compound, about one-eighth inch wide, made around the hole through which ants entered a room or across their trail was an effective barrier. It appeared that most of them touched the line with their feet or antennae and became paralysed and died within a few hours.

COON (B. F.). **Duplicating Japanese Beetle Injury in Field Corn.**—*J. econ. Ent.* **38** no. 5 pp. 604-605, 1 fig. Menasha, Wis., 1945.

Adults of the Japanese beetle [*Popillia japonica*, Newm.] annually invade fields of maize in south-eastern Pennsylvania during July, while it is being pollinated, and congregate on the silks, cutting them down to the husk and preventing fertilisation to varying degrees. Since other agents, such as drought, may cause similar damage, attempts were made to simulate and evaluate the effect of Japanese-beetle feeding by cutting silks at various intervals after pollination. Developing ears were covered with bags before the silks appeared, and when the latter were numerous and receptive, collected pollen was poured over them, and the ear was covered again. At periods of 6-48 hours after pollination, the silks and an inch of the husk were cut off, after which the ear was protected until harvest. The results showed that when the silks were cut six hours after pollination, fertilisation was poor and similar to that occurring after Japanese-beetle injury. When they were cut after seven hours, the ears were well fertilised, with some injury similar to typical beetle injury at the tip and base; and when they were cut after 12-48 hours, fertilisation was very good.

DICKSON (R. C.) & SANDERS (E.). **Factors inducing Diapause in the Oriental Fruit Moth.**—*J. econ. Ent.* **38** no. 5 pp. 605–606, 1 ref. Menasha, Wis., 1945.

In the course of rearing *Cydia (Grapholitha) molesta*, Busck, for experimental purposes in small green apples in the laboratory in California during the winter of 1943–44, it was found that a high percentage of the larvae and prepupae went into diapause, although they were kept at a temperature of 80°F. Investigations on factors that might influence this behaviour showed that the percentage of diapausing individuals increases with the number of hours of light per day during the feeding periods to a very high figure at about 12 hours, but decreases abruptly to almost zero at 15 or more hours per day, the effect being cumulative with apparently no critical point during the period. This reaction to light agrees with field experience, since *C. molesta* enters hibernation during the late summer and autumn, often while the weather is still warm, and is similar to that observed in certain mosquitos [*R.A.E.*, B **24** 110]. The percentage that diapaused was also increased by low temperatures during the larval feeding and prepupal periods.

In accordance with these results, large numbers of *C. molesta* were reared in the laboratory during the winter of 1944–45 by keeping electric lamps burning continuously in the room in which the larvae were feeding and by keeping the temperature at 76–80°F. Under these conditions there was no appreciable amount of diapause.

NICKELS (C. B.) & PIERCE (W. C.). **DDT and Lead Arsenate compared for Control of the Pecan Nut Casebearer.**—*J. econ. Ent.* **38** no. 5 p. 607. Menasha, Wis., 1945.

In field tests carried out in Texas in 1944, a spray of 1½ lb. technical DDT mixed with 1½ lb. pyrophyllite per 100 U.S. gals. was compared with one of 6 lb. acid lead arsenate per 100 U.S. gals. for the control of *Acrobasis caryae*, Grote, on pecan. Applications were made on 23rd May, when about 26 per cent. of the first-generation eggs observed on the previous day had hatched. Zinc sulphate (3 lb. per 100 U.S. gals.) was added to the lead-arsenate spray and, for some trees, to the DDT spray and also applied to the control plot against pecan rosette. The percentages of nuts retained at the end of the feeding period of the first generation and at harvest in 50 clusters from each of ten trees receiving each treatment were 82.9 and 78.1 for lead arsenate, 76.1 and 67.4 for DDT alone, 77.8 and 68.5 for DDT with zinc sulphate and 64.7 and 56.8 for zinc sulphate only, the differences required for significance ( $P=0.01$ ) being 5.1 and 7.2 respectively. The inferior results given by the DDT sprays may have been due to the fact that the DDT and pyrophyllite did not mix well with water, so that the suspension in the spray tank was not entirely satisfactory. Observations in October showed that larvae of *Datana integerrima*, Grote & Rob., caused some defoliation on seven of the 20 trees that had been sprayed with DDT, but practically none on the ten trees that had been sprayed with lead arsenate. DDT did not injure the trees.

In a laboratory test, groups of unsprayed second-growth pecan shoots and shoots sprayed with DDT or lead arsenate and zinc sulphate were each infested with one egg of *A. caryae* that was almost ready to hatch. Examination after 4–5 days to determine the effect of the treatments on the newly hatched larvae showed that 6, 67 and 55 per cent., respectively, of the larvae were dead.

CHAPMAN (A. J.), FIFE (L. C.) & MCGARR (R. L.). **DDT for Control of the Onion Thrips.**—*J. econ. Ent.* **38** no. 5 pp. 608–609. Menasha, Wis., 1945.

The results are given of experiments on the control of *Thrips tabaci*, Lind., on onion with dusts of 2.5, 5 or 10 per cent. DDT in pyrophyllite, carried out

in April 1944 in the lower Rio Grande Valley of Texas. All the treatments caused a significant reduction in the thrips population on onion plants 24 hours after dusting. There was no significant difference between the 5 and 10 per cent. dusts with dosages ranging from 9 to 27 lb. of the mixture per acre, but the reduction in population in general was greater as the amount of DDT per acre was increased. These two dusts were still effective 96 hours after application, although the number of thrips had increased on all plots. A second application of the 5 and 10 per cent. dusts four days after the first again caused significant reductions in population, with no significant difference between them.

KULASH (W. M.). **DDT and "Control" of Honeybees.**—*J. econ. Ent.* **38** no. 5 pp. 609–610, 1 ref. Menasha, Wis., 1945.

The eradication of a colony of honey bees that had become established under the framework of the main doorway of a house, with several entrances in the mortar spaces between the courses of brick underneath, is described [*cf. R.A.E.*, A **33** 345]. In early May, a DDT spray (2 fl. oz. of 5 per cent. Gesarol SH–5 per U.S. quart water) was applied to the area round the entrance holes, and before the treated area dried it was dusted with 3 per cent. DDT, which was also dusted into the entrance holes. A week later, a 5 per cent. DDT dust was applied to the area about the entrance holes, and about 2 oz. of it dusted into the holes.

Some bees became incapacitated within 20–30 minutes of the first treatment and within 15 of the second, and ten days after the second the colony was nearly eradicated and was being visited by robber bees, which entered by holes that had not been treated. Two weeks after the second treatment, numerous robbers were leaving the colony well covered with DDT dust, and three weeks later the colony had been eradicated, the honey had been removed by robber bees and these were no longer about.

It is concluded that an undesirable bee colony is easily eradicated with DDT, but that the danger of poisoning desirable colonies from which bees may come to rob the weakened colony should be determined before it is used near hives.

OSBURN (M. R.). **Methyl Bromide for Control of the Pineapple Mealybug.**—*J. econ. Ent.* **38** no. 5 p. 610. Menasha, Wis., 1945.

*Pseudococcus brevipes*, Ckll., which causes pineapple wilt, and is the most serious insect pest of pineapple in Florida, often occurs on the suckers and slips taken from established plants to form new plantings. This material is sometimes dipped in oil emulsion or fumigated with hydrocyanic acid gas before being planted [*cf. R.A.E.*, A **28** 146, 257], but these treatments sometimes injure it and usually fail to eliminate all the mealybugs. In tests made with methyl bromide during 1944, the slips and suckers were packed tightly in crates, and the crates were stacked in a box enclosure consisting of a wooden frame standing on the ground and covered with tarred roofing paper and tarpaulins. The edges rested in a shallow trench, and soil was thrown up round the outside to confine the gas. The methyl bromide was admitted through copper tubing into a shallow pan in the box, and a small fan provided air circulation. Exposure for two hours to 2 lb. methyl bromide per 1,000 cu. ft. at 92–103°F. or 74–77°F. or to 1 lb. at 79–88°F. gave complete mortality of the mealybug. The material was planted soon after, and the plants were normal and healthy in the spring of 1945. In further tests in 1945, a metal-lined box with a capacity of 50 cu. ft., constructed to maintain constant temperature and prevent the escape of the fumigant, was used, and fumigation with 0.5 lb.

methyl bromide per 1,000 cu. ft. for two hours at 80°F. gave almost complete mortality, 374 dead mealybugs and 6 live ones being found in three tests in samples of material from the middle of the packed crates.

These results indicated that fumigation with methyl bromide at 1 lb. per 1,000 cu. ft. for two hours at 79–88°F. would eliminate *P. brevipes* from planting material and would not injure the plants. It was observed that the 2-lb. dosage caused complete mortality of the pineapple mite, *Stigmaeus floridanus*, Banks, but the lower dosages were less effective.

MANTER (J. A.). **DDT for the Tent Caterpillar.**—*J. econ. Ent.* **38** no. 5 p. 615. Menasha, Wis., 1945.

In laboratory tests with DDT insecticides for the control of *Malacosoma americana*, F., which was abundant and apparently near the peak of one of its cycles in Connecticut during the spring of 1945, Gesarol Summer Oil spray applied to a tent with a medicine dropper penetrated it and affected the larvae, which became partly paralysed. All were dead in two days. When another tent was sprayed with about 1.7 cc. of the spray, the caterpillars began to leave the tent within three minutes; all were quiet at the end of ten minutes and dead by the next day. Several of 25 larvae that were placed on this tent two days later left it within ten minutes; these were placed in a clean cage, and half were dead by the following day and the rest the day after. Larvae that were feeding when their tent was sprayed soon returned to the tent, but did not enter it; before long, they left it again, not following their normal trails, and all became paralysed and died. Spraying 22 large larvae on a tent with 3.4 cc. of a mixture of Gesarol emulsion with water (1:1,000) caused them to begin to drop within five minutes and all had left the tent in 15 minutes; they became paralysed and died one or two days later.

In field tests, tents were sprayed with 0.32–3.6 cc. Gesarol Summer Oil spray or dusted with 0.35–1.05 gm. Gesarol A3 dust, and later observations failed to reveal living larvae. It is concluded that DDT is an effective contact poison for tent caterpillars even when greatly diluted.

WITTMER (S. H.) & HASEMAN (L.). **Soil Nitrogen and Thrips Injury on Spinach.**—*J. econ. Ent.* **38** no. 5 pp. 615–617, 1 fig. Menasha, Wis., 1945.

In the experiments described, plants of New Zealand spinach (*Tetragonia expansa*) were grown in Missouri under controlled conditions in clay-sand cultures, containing all possible combinations of 5, 10, 20 and 40 milliequivalents of calcium from calcium acetate and the same of nitrogen from ammonium nitrate and constant amounts of all other nutrients, in a greenhouse infested with *Heliothrips haemorrhoidalis*, Bch. None of the plants grown at the two higher nitrogen levels was seriously attacked during the first six weeks of growth, and practically all those at the two lower nitrogen levels were badly damaged, though attack was less serious on those with the higher calcium supply. Detailed chemical analysis of the plants showed that those selected for food by the thrips made less total growth and were richer in vitamin C, oxalate and phosphorus and poorer in total nitrogen than the others; the predominating influence of the nitrogen increments on growth, chemical composition and incidence of insect damage was obvious. In interpreting these results it is pointed out that most insects have specific food-plants, which probably indicates that they have definite food requirements; that the nutrient contribution of a food-plant may be altered much by soil fertility; that the value of crop rotation in insect control may be partly due to better maintenance of soil fertility; and that the constant need for the development of new insecticides to control increased insect infestation may be aggravated by a gradual but general decline in soil fertility from year to year.

LINDGREN (D. L.) & SINCLAIR (W. B.). **Sorption of HCN by Insect Pupae.**—*J. econ. Ent.* **38** no. 5 p. 617, 1 graph, 3 refs. Menasha, Wis., 1945.

The toxicity of a fumigant to insects depends on the chemical constitution of the compound and its physical and chemical properties in the gaseous phase, on the effect of temperature and relative humidity on both the fumigant and the insect, and on the physiology of the insect at different stages of development; even when two species of insects sorb the same amount of fumigant under identical conditions, the lethal dosage may be very different for the two species. Apart from the variation in tolerance of insects to a given fumigant, all these factors bear a definite relation to the sorption of the fumigant by the insect during the period of exposure, and as part of a study of the physical, chemical and physiological factors that affect the sorption of hydrocyanic acid gas by insects, the amounts sorbed by pupae of *Musca domestica*, L., at different ages were investigated. Samples of pupae from a single source were fumigated on successive days with 16.8 mg. HCN per litre for 40 minutes at a temperature of 75°F. and 48–78 per cent. relative humidity, and the HCN was recovered from them immediately. The amount recovered decreased from nearly 0.8 mg. per gm. of pupae on the first day (one day after pupation) to about 0.4 mg. on the third day, remained approximately constant until the fifth day and then increased steadily to 0.95 mg. on the eighth day, when the adults were about to emerge.

The amounts recovered were plotted on a graph, and the curve produced followed the mortality curve previously obtained for pupae of *Tribolium confusum*, Duv., of different ages when fumigated with a given concentration of chlorpicrin, to which they were least resistant at the beginning and end of the pupal stage and most resistant from the second to the fourth day [*cf. R.A.E.*, A **24** 777].

FROST (S. W.). **A new Leafhopper on Cherry.**—*J. econ. Ent.* **38** no. 5 pp. 617–618, 3 refs. Menasha, Wis., 1945.

*Cicadella stellulata*, Burm. (*Typhlocyba inscripta*, Sanders & DeL.), a European Jassid recorded on pear in Connecticut in 1922, was found on sour cherry in Pennsylvania on 20th June 1945 and became more abundant during July and August. The nymphs and adults caused white stippling of the leaves, and this injury was already conspicuous on 20th June. Adjacent sweet cherry trees and pear trees only 50 ft. away showed no evidence of attack.

MUNSON (S. C.) & YEAGER (J. F.). **DDT-like Effects from Injection of other Compounds into Roaches.**—*J. econ. Ent.* **38** no. 5 p. 618, 1 ref. Menasha, Wis., 1945.

Molar concentrations of DDT and other compounds were injected into nymphs of *Periplaneta americana*, L., and the various compounds compared with DDT with regard to the symptoms produced and the speed of kill of the most effective doses. In the results that follow, the number given in brackets after the name of each compound is the reciprocal of the survival time for the most effective dose of the compound divided by the survival time of a corresponding dose of DDT, so that compounds that exceeded DDT in speed of kill have an index greater than unity. Symptoms very similar to those caused by DDT were produced by p-dichlorobenzene (1.08), hydroquinone in 1.1 per cent. sodium chloride (4.88), hydroquinone in maize oil (1.07), aniline (1.91) and phenol (1.47). Diphenylamine (1.52) and benzene (ca. 0.5) produced symptoms only moderately like those caused by DDT. Symptoms not like those caused by DDT were produced by o-chlordiphenyl (0.13), dibenzyl (0.46), p-nitrophenol (3.3), toluene (0.1), benzoic acid (0.68), salicylic acid (0.35), xylene (0.12) and phenothiazine (8.63). Pyrogallol in 1.1 per cent. sodium chloride (1.13),

p-phenylenediamine (1.2), alpha-naphthol (0.49), dimethyl-p-phenylenediamine (1.24) and tetrachlorhydroquinone (4.46-6.24) were intermediate in effect between the first and second groups and chloral hydrate (0.74), diphenyl (0.51) and tetrachlorbenzene (0.87) were intermediate between the second and third.

The values for speed of kill show that benzene was less effective than DDT but that a benzene ring with Cl, OH or NH<sub>2</sub> substituted in the para position could be as effective as DDT or more effective. The results are in agreement with the view that the DDT molecule consists essentially of a toxic (aromatic) portion chemically combined with a carrier (chloral) portion, the latter being considered chiefly responsible for the penetration properties of the molecule [cf. R.A.E., A **33** 137]. Minimum lethal doses, which were estimated for the more toxic compounds, seemed to be greater for compounds that were more soluble in water, suggesting that the more water-soluble compounds might be excreted more readily than the others. Some of the compounds are known to be oxidised by the cytochrome enzyme system, and the first three in the fourth group have long been used in the histochemical detection of indophenol (cytochrome) oxidase. These facts, together with the results given, suggest that an effect upon the cytochrome oxidase system in the insect might be a part of the mode of action of DDT.

ABBOTT (C. E.). **The toxic Gases of Lime-sulphur.**—*J. econ. Ent.* **38** no. 5 pp. 618–620, 2 graphs, 6 refs. Menasha, Wis., 1945.

The author states that when air is passed through a solution of lime-sulphur, hydrogen sulphide is generated in greater quantities than sulphur dioxide and is the primary cause of the insecticidal action of the gases since it is the stronger reducing agent and the more toxic. The last point was confirmed by comparing the effect of the two gases on the heart rate of specimens of *Popilius disjunctus*, Ill. (*Passalus cornutus*, F.) and *Polistes fuscatus*, F.

The decomposition of lime-sulphur proceeds slowly when air free of carbon dioxide is passed through it, but requires less than two hours when air containing small quantities of carbon dioxide is used and little more than half an hour with a mixture of equal parts of air and carbon dioxide. When the gases evolved were collected for successive intervals of three minutes in numbered test tubes containing silver nitrate solution, the relative amounts of silver sulphide and silver sulphite formed showed the proportion of hydrogen sulphide and sulphur dioxide given off. Comparison of the results showed that only small quantities of free sulphur dioxide were produced, and that this soon ceased to appear, since it was reduced by the excessive hydrogen sulphide. When the gases were conducted into a series of vessels containing blowflies (*Lucilia sericata*, Mg.) and the containers, after an exposure of three minutes each to the gases, were left open until some of the flies became active and then loosely plugged with cotton and left for 24 hours, the percentage mortality was found to be closely correlated with the production of hydrogen sulphide.

PHILLIPS (A. M.). **An unusual Habit of the Pecan Budmoth in Florida.**—*J. econ. Ent.* **38** no. 5 p. 620, 1 fig. Menasha, Wis., 1945.

On 6th and 7th November 1944, while pecan husks infested with immature stages of *Enarmonia* (*Laspeyresia*) *caryana*, Fitch, were being collected in Florida, large numbers of larvae and pupae of *Gretchena bolliana*, Sling., were found between the husk and shell of the nuts. The cocoon had been spun in the opening between the sections of the husk, and the frass in the webs indicated that the larvae had fed on the husks. Adults began to emerge on 9th November and continued to do so throughout November, December (when the weather

was unusually cold for the area), January and February. As this Tortricid is considered to be primarily a bud feeder, it is assumed that this late brood of larvae migrated from the buds to the pecan nuts for some unusual reason.

HOPPING (G. R.). **The Lodgepole Pine Needle Miner in the Canadian Rocky Mountain Parks (Lepidoptera, Gelechiidae).**—*Proc. ent. Soc. B.C.* **42** pp. 1-2, 3 refs. Vernon, B.C., 1945.

A heavy infestation of the needles of lodgepole pine (*Pinus contorta*) by *Recurvaria milleri*, Busck, was observed in Banff National Park, Alberta, in early June 1942, when the foliage of the trees turns reddish-yellow over large areas at altitudes of 5,000-6,500 ft. on both sides of the Bow River. The injury occurred in the middle of an area of bark-beetle control and was at first attributed to increased attack by bark-beetles. By 1944, the heavily infested area had extended westward into British Columbia, and southward for a distance of 8-10 miles into the Kootenay Park. The life-history of the Tineid was similar to that observed in California [*R.A.E.*, A **9** 391], except that at Banff adult emergence occurred only in the even- instead of the odd-numbered years. In 1942, peak emergence occurred between 19th and 24th July and over 60 per cent. of the moths had emerged by 26th July.

In general, the trees were not permanently damaged by the attack, but some of the older ones in one area in Alberta appeared to be dying in September 1944. In another mature stand, the weakening of the trees appeared to attract bark-beetles from neighbouring areas, and it was necessary to mark and burn trees infested by beetles in three successive years instead of the two required elsewhere. The risk of secondary attack by bark-beetles on mature trees is considered to be the most important problem raised by the outbreak, but much of the affected area is occupied by young growth. No indication of any material decrease in populations of *R. milleri* was obtained; several parasites were recovered, but examination of needles showed that parasitism was less than 20 per cent.

GLENDENNING (R.). **Population Counts of Potato Flea Beetles at Agassiz and Chilliwack, B.C. (Coleoptera: Chrysomelidae).**—*Proc. ent. Soc. B.C.* **42** p. 2. Vernon, B.C., 1945.

Counts of flea-beetles on potato foliage made each year since 1941 at two districts in the lower Fraser Valley, British Columbia, have shown a great increase in the numbers of *Epitrix tuberis*, Gentner [*cf. R.A.E.*, A **35** 13] and decrease in the numbers of *E. subcrinata*, Lec. The latter made up 75 per cent. of the population in 1941, about 50 per cent. in 1942, less than 10 per cent. in 1943 and less than 4 per cent. in 1944, when it was not taken in appreciable numbers even in May, before *E. tuberis* becomes abundant. The reason for this decline is not known, but the great increase in numbers of *E. tuberis* may have been partly responsible. Neither species was parasitised to any extent.

BUCKELL (E. R.) & SPENCER (G. J.). **A preliminary List of the Flesh Flies of British Columbia (Diptera: Sarcophagidae).**—*Proc. ent. Soc. B.C.* **42** p. 6. Vernon, B.C., 1945.

In connection with work on the natural control of grasshoppers in Canada [*cf. R.A.E.*, A **32** 297], Sarcophagid flies were collected in the field and reared from their Acridid hosts in two areas in British Columbia. A list is given of the species obtained, showing those that have been recorded as parasites of

grasshoppers in North America and those that were reared from *Melanoplus mexicanus mexicanus*, Sauss., in British Columbia. The latter comprise *Sarcophaga sinuata*, Mg., *S. hunteri*, Hough, *S. opifera*, Coq., *S. falciformis*, Aldr., *S. reversa*, Aldr., *S. rapax*, Wlk., *S. tuberosa*, Pand., vars. *harpax*, Pand., *sarracenioides*, Aldr., and *exuberans*, Pand., *S. kellyi*, Aldr. [cf. 34 227], *S. (Blaesoxiphotheca) coloradensis*, Aldr., and *S. (Acridiophaga) aculeata*, Aldr.

TURNBULL (W. H.). **History of the Use of Bee Repellents in Orchard Sprays in the Okanagan Valley of British Columbia.**—*Proc. ent. Soc. B.C.* 42 pp. 7-8, 3 refs. Vernon, B.C., 1945.

Experiments with repellents to be added to insecticidal sprays to protect honey bees from poisoning were carried out in orchards in the Okanagan Valley, British Columbia, in 1942-44. The repellents tested were creosote and crude carbolic acid, and they were added to the standard lead-arsenate sprays at concentrations of 1 pint and 2 oz. per 100 gals., respectively. In 1942, when they were used in an isolated orchard, no bees were lost from hives placed in the orchard and the yield of honey was satisfactory, whereas losses were heavy in an apiary a few miles distant that was within flying distance of an orchard in which repellents were not included in the sprays. Equally good results were obtained in tests on a larger scale in 1943 in an orchard with a cover crop of plants visited by bees, but creosote in sprays applied by growers in the same year scorched the foliage of the trees [cf. *R.A.E.*, A 32 254; 34 55], probably owing to incomplete mixing of the spray. On this account, only crude carbolic acid was tested in 1944. It was applied in four cover sprays, in the last of which the concentration was increased to 4 oz. per 100 gals., under varying conditions of atmospheric humidity, in an orchard with a heavy cover crop in full bloom during at least two applications. No injury to the foliage occurred, and no bees were lost in this orchard or in several others in which carbolic acid was used by the growers.

SPENCER (G. J.). **Naphtha Gasoline in Insect Killing Bottles.**—*Proc. ent. Soc. B.C.* 42 p. 16. Vernon, B.C., 1945.

When making population counts of grasshoppers, it is often necessary to kill large numbers in a short time. Dipping the end of the net containing the insects in a jar of methyl alcohol was effective, but the alcohol quickly became dirty, and naphtha gasoline used in the same way proved more satisfactory. It kills immediately any insect that it wets, penetrates a mass of grasshoppers in a few seconds, evaporates rapidly, and cleans the insects by removing the grease from them. It was also effectively applied by pouring it on to the insects in the end of the net and allowing it to drip into a small can, when it could be used again. It can be employed to kill individual insects by pouring a little into a shell vial, 1 in. in diameter, half way down which a wire-gauze disk has been pushed, placing the insect in the vial, and inverting the latter for a moment. The insect should be removed with forceps immediately, as long immersion induces a rigor as a result of which the legs become brittle and may break off.

SPENCER (G. J.). **On the Destruction of all Stages of Insects in pulverized Cereals and Spices.**—*Proc. ent. Soc. B.C.* 42 p. 16. Vernon, B.C., 1945.

A patented mechanical contrivance for controlling insects in all types of pulverised cereal products and spices and possibly also in commercial fertilisers

containing fish-meal has recently become available in Canada and the United States. It consists of a hopper-fed machine that hurls the material with forced draught through a nozzle and against a plate, thus destroying any insects present.

İYRİBOZ (Nihat). **Pamuk Hastalıkları.** [Pests and Diseases of Cotton.]—*Publ. Minist. Agric. Turk. Rep.* no. 237, 3rd edn., 140 pp., 2 col. pls., text ill., many refs. Ankara, 1941.

The largest section in this bulletin on pests and diseases of cotton in various parts of the world deals with insects and a shorter one with mites. The pests are arranged systematically, and their distribution and the type of injury caused by each are reviewed. Those that occur in Turkey are specially indicated. Information on morphology, bionomics and control is included in the case of the more important species. A key by which various pests may be identified from the type of damage caused is appended.

TAYLOR (G. G.). **Experiments with Spray Treatments for Control of Diseases and Pests of Raspberries.**—*N.Z. J. Sci. Tech.* **27** (A) no. 2 pp. 83–90, 1 ref. Wellington, N.Z., 1945.

Fungous diseases and insects are thought to be largely responsible for the reduced yield of raspberries in the Nelson Province of New Zealand of recent years, and the experiments here described were carried out in 1940–45 to ascertain whether they could be controlled and the yield increased by means of combined sprays. The fungi of importance during the tests were *Elsinoe veneta* (cane-spot) and *Septoria rubi* (septoria-spot), and the insect considered to be of the greatest significance was *Carposina adreptella*, Wlk. [cf. *R.A.E.*, A **28** 313]. Lead arsenate was included against it at 2 lb. per 100 gals. In 1940–41, all plots received Bordeaux mixture (5 : 4 : 50) on 29th September (green-tip stage) and two applications of Bordeaux mixture (3 : 4 : 50) and lead arsenate on 26th October (early open-cluster) and 26th November (fruit set), and one series received two further applications of the combined spray after picking, on 11th February (full-foliage) and 26th March (quarter foliage-fall). Control of the fungi was satisfactory, and better for five sprays than for three. Damage to buds by *Carposina* was noticed from March onwards, and counts taken in July showed 24·6 per cent. damaged buds in plots that received three applications, 6·8 per cent. in those that received five, and 38·7 per cent. in the untreated controls; the difference required for significance (at the 5 per cent. level) was 16·4. In 1941–42, all plots received a spray of Bordeaux mixture (5 : 4 : 50) and lead arsenate on 13th October (advanced green-tip stage) followed in one series by four applications of Bordeaux mixture (3 : 4 : 50) and lead arsenate on 3rd November (open-cluster), 1st December (fruit-set), 16th February (full-foliage) and 10th April (quarter foliage-fall) and in the other by Bordeaux mixture (3 : 4 : 50) and lead arsenate on 1st December and 16th February and Bordeaux mixture (5 : 4 : 50) and lead arsenate on 5th May (foliage-fall). Fungus control was again satisfactory. Counts in July showed 6·8 and 6·4 per cent. of the buds infested by *Carposina* for the two series, respectively, as compared with 20 per cent. in the controls, a difference of 5·8 being significant.

Further tests were carried out in another locality in the three seasons of 1942–45 in which Bordeaux mixture (5 : 4 : 50) and lead arsenate was applied at the green-tip stage and Bordeaux mixture (3 : 4 : 50) and lead arsenate at the open-cluster and full-foliage stages and half or quarter foliage-fall.

A portable outfit driven between the rows was used for the first spray of the season, but later sprays were applied with long hoses, to avoid damaging the canes. Fungous infection was again much reduced on the sprayed plots. In 1943-44, 500 fruits taken at random from each plot showed 16.8 per cent. infestation by *Carpocina* on sprayed plots and 24.6 per cent. on controls, a difference of 5.8 being significant. Records of infested buds taken in July showed mean percentage infestations in sprayed plots and controls, respectively, of 7.9 and 43.6 in 1943 and 10.8 and 47.4 in 1944, the differences required for significance being 18.5 and 11.8. The yields from treated plots were equal to 41.5, 48.6 and 43.9 cwt. per acre in the three seasons, as compared with 40, 38.9 and 29.5 cwt. in the controls. The increase in 1942-43 was small, because damage to fruiting canes had already occurred in the previous season. There was a marked increase in the vigour of growth of the canes over the three seasons. The high incidence of damaged buds in the controls as compared with the sprayed plots (8.0 and 38.4 per cent., respectively, over the five seasons) suggests that control of *C. adreptella* was highly important in increasing yield, and the inferior control obtained when post-harvest sprays were omitted suggests that insecticidal applications in the late summer are particularly important.

DUMBLETON (L. J.). **Contribution to the Ecology of *Oxycanus cervinata* Walk.**—*N.Z. J. Sci. Tech.* **27** (A) no. 2 pp. 114-128, 11 figs., 7 refs. Wellington, N.Z., 1945.

An account is given of field and laboratory studies on *Oxycanus cervinatus*, Wlk., in New Zealand, chiefly in the South Island, in 1939-45. The eggs, most of which are laid in October and November, hatched in about a month, the larvae were full-fed by about the end of April and pupated in late July, August or September, and the pupal stage lasted about 40 days. The larvae remain on or near the surface of the soil for about a month after hatching and grow most rapidly during February-April; damage to pastures consequently increases during this period, and observations indicated that a population of 10-12 per square foot can completely defoliate a pasture of rye grass [*Lolium perenne*] and white clover [*Trifolium repens*]. No evidence of migration of the larvae was obtained. They could survive cultivation; barley sown in March in a field from which wheat was harvested in January was severely damaged. The date of pupation and duration of the pupal stage appeared to be determined chiefly by soil temperature. Flights of adults were observed in different localities between late September and early December. Large flights appeared to follow warm days [cf. *R.A.E.*, A **34** 209] and to occur soon after sunset under favourable conditions. The moths do not feed and did not survive for more than four days.

Laboratory experiments showed that the eggs can survive at 77°F. but not at 84°F. and indicated that the threshold of development is 44°F. They developed most rapidly and with least mortality at 100 per cent. relative humidity, especially if they were on a moist substratum. Mortality was not increased significantly by daily fluctuations in relative humidity between 70 and 100 per cent., but was considerably increased by a reduction of the relative humidity to 70 per cent. during the second half of the incubation period. Newly-hatched larvae kept without food at 20°C. [68°F.] survived longest (up to a fortnight) when the atmosphere was saturated, and mortality among them increased with decreasing humidity; those kept in a saturated atmosphere at different temperatures survived longer at 20°C. than at 30°C. [86°F.], and longer still (up to three weeks) at 7.2 [44.96].

Records of parasites of *Oxycanus* spp. in New Zealand are reviewed from the literature; those observed by the author were the Tachinids, *Hexamera alcis*,

Wlk., *H. signata*, Wlk., and *Cerosomyia usitata*, Hutton. Adults of *H. alcis*, which was the most numerous, were observed to emerge from 12th October until 9th December and were taken in numbers in mid-January. They were most active between 4 and 5 p.m., when they flew and crawled over the grass. The females exhibited an oviposition reflex on coming in contact with the webbing that indicates the presence of larvae of *Oxycanus*. The larvae frees itself immediately from the egg membrane in which it is deposited and searches for a host. On finding one it rapidly enters it and penetrates into the body-cavity. It passes through three instars in the host larva and then leaves it and pupates in its tunnel. The durations of the instars are not known, but a third-instar larva was found in late August, and both larvae and puparia in late October. *H. alcis* appeared to be of considerable importance in the control of *Oxycanus* in sheltered park-like areas but not in open grasslands. Parasites that emerged from the puparia of this Tachinid in early December were identified as the Diapriid, *Malvina punctata*, Cam. *H. signata*, though less common than *H. alcis*, is widely distributed throughout both Islands; adults were taken in the field between November and February, and two emerged from field-collected puparia at the end of October. *Cerosomyia usitata* emerges from the larvae or pupae of *Oxycanus*, and the pupal period is about one month. Predators included insectivorous birds, seagulls, which fed in numbers on larvae driven from their tunnels by flooding, and Carabid larvae, which were fairly common in some heavily-infested pastures. Larvae attacked by the fungus, *Metarrhizium anisopliae*, were found on several occasions, and it appeared likely to be of value in some seasons and soils. The trophozoites of a Gregarine, tentatively determined as *Lankesteria* or *Diplocystis*, were common in the larvae, but did not apparently harm them.

It is concluded that natural enemies and diseases do not influence the abundance of *O. cervinatus* over extensive areas. Competition for food may do so, but only after severe economic damage has been caused. The experiments suggest that the effect of soil temperature and moisture on the eggs, and possibly on the young larvae, is of practical importance, and this view is supported by the observed tendency of infestations to occur on slopes with a southern aspect and to recede in years when rainfall is light to areas on heavy soil and with the heaviest rainfall. At least two consecutive favourable seasons are probably necessary to induce an outbreak, especially in areas that are generally unfavourable. A heavy outbreak occurred in Canterbury and North Otago in 1937, and data for rainfall, evaporation and soil moisture in November (when the eggs are present) during the period 1934-44 indicate that soil moisture in 1935 and 1936 was of the order of 24 per cent. and higher than in any other November during the 11 years.

Of the ten lowland species of *Oxycanus* that occur in New Zealand, the only others likely to build up large populations on pasture land are *O. jocosus*, Meyr., *O. despectus*, Wlk., and *O. umbraculatus*, Guen. *O. despectus* was found to be causing extensive damage to pastures in the higher rainfall country of north-west Nelson. Only larvae were observed in late November, when they also injured peas sown a month earlier in a field previously under grass. Adults began to emerge at the end of December, and both adults and pupae were collected in the following February.

TAYLOR (G. G.). Preliminary Field Trials with D.D.T. and 666 against Insect Pests.—*N.Z. J. Sci. Tech.* 27 (A) no. 2 pp. 129-133, 1 ref. Wellington, N.Z., 1945.

The results are given of tests carried out in New Zealand in 1944-45 on the comparative value of DDT and 666 (benzene hexachloride) for the control of

various agricultural pests. The 666 consisted of a mixture of the four isomers of benzene hexachloride and contained about 10 per cent. of the  $\gamma$  isomer [R.A.E., A **33** 256-257]; sprays were prepared from a powder containing 50 per cent. 666 with the addition of sulphite lye [cf. **33** 257], and a gypsum dust containing 20 per cent. 666 was diluted with magnesite talc for the dusting experiments. DDT dusts were prepared by adding a solution of DDT in acetone to finely-ground magnesite talc, removing the solvent and diluting the resultant dust with additional carrier to the required concentrations, and the sprays were prepared from DDT crystals and a wetting agent (Agral 2) in water ground in a ball mill.

In cage experiments against adults of *Odontria zealandica*, White, apricot trees were sprayed with DDT or 666 at concentrations of  $\frac{1}{4}$ -2 lb. per 100 gals. or lead arsenate at 2-16 lb. per 100 gals., and the beetles were given fresh leaves from the trees daily for four days, beginning one or 16 days after the sprays were applied. They fed freely on leaves sprayed with lead arsenate and 666 and on the controls, but not on those sprayed with DDT. In the test begun on the day after spraying, all concentrations of DDT and all but the lowest of 666 gave similar mortalities (about 66 per cent.), but the lowest concentration of 666 was markedly inferior and not significantly better than no treatment. After 16 days' weathering DDT showed little or no loss of effectiveness, but the mortalities given by 666 were low and significant only at the highest rate. Lead arsenate was ineffective.

In tests against *Cavariella aegopodii*, Scop., in experimental plots of carrots, six applications of sprays containing 1 lb. DDT, 2 lb. 666 or 1 gal. nicotine sulphate with 3 lb. potassium soap to activate it, all per 100 gals., were made at intervals of about ten days. The Aphid became established soon after the first application and rapidly increased in numbers on the control plots. The mean numbers of Aphids on samples of 28 leaves and (in brackets) the mean weight of roots in ounces were 213 (412) for 666, 437 (368) for DDT, 63 (271) for nicotine sulphate, and 22,000 (24) for no treatment, a difference of 118 (76) being significant (at the 5 per cent. level). Plants sprayed with DDT and 666 were more vigorous than those sprayed with nicotine sulphate, and the lower yield of the latter is attributed to possible injury by the soap in the spray.

In experiments against *Pieris rapae*, L., cabbage plants were sprayed or dusted five times at intervals of about ten days between 10th February and 29th March. The results were assessed at harvest and showed that the percentages of heads in which the cover leaves and hearts were undamaged were 10.4 for a spray of  $\frac{1}{2}$  gal. nicotine sulphate and 2 $\frac{1}{2}$  lb. lead arsenate, 10.7 and 18.2 for 1 or 3 lb. derris powder (4 per cent. rotenone content), 76.3 and 89.5 for  $\frac{1}{2}$  and 1 lb. DDT and 15.2 and 18.6 for  $\frac{1}{2}$  and 1 lb. 666, all per 100 gals., and 60.9 and 70.2, 20.8 and 38.8, and 35.3, respectively, for dusts of 1 and 2 per cent. DDT, 1 and 2 per cent. 666 and a derris mixture (0.5 per cent. rotenone), the difference for significance being 14. If some damage to the cover leaves was ignored, both sprays and dusts of DDT and the stronger 666 dust gave highly satisfactory commercial control.

In tests against *Cydia pomonella*, L., dwarf apple trees were sprayed eight times between 7th November and 3rd March with DDT or 666 at 1 lb. or lead arsenate at 1 $\frac{1}{2}$  lb. per 100 gals. The percentages of fruits infested were 0.9 for DDT, 8.9 for lead arsenate, 27.8 for 666 and 46.7 for no treatment, a difference of 14.1 being significant. Populations of *Paratetranychus pilosus*, C. & F., and, to a lesser extent, *Bryobia praetiosa*, Koch, increased rapidly early in the season on the trees sprayed with DDT and caused bronzing of the leaves and defoliation. There was a smaller increase in mite populations on trees sprayed with 666.

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